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VOL. V., NO. 3 NEW YORK, MARCH, 1908 $1.00 a year, 10 cents a copy

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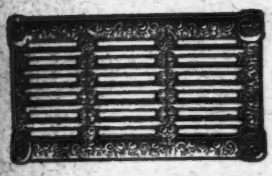

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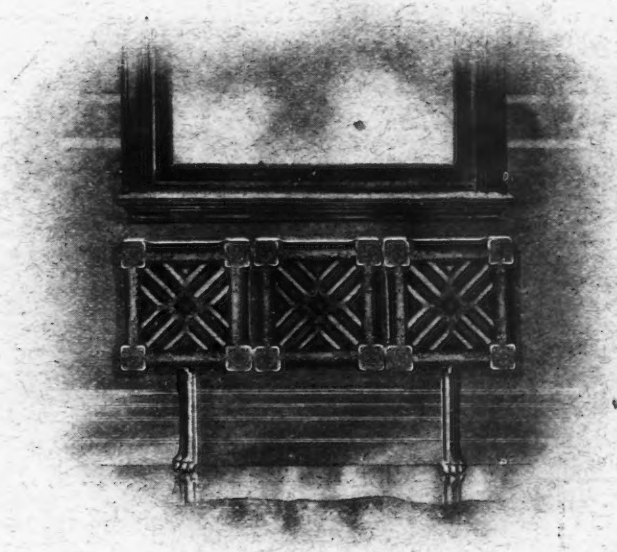

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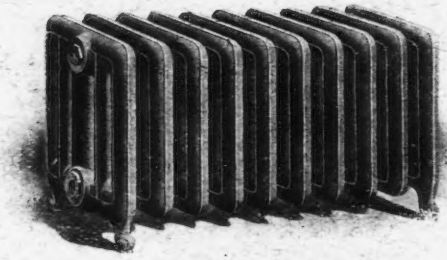

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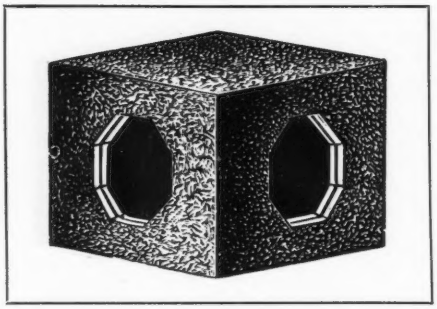

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The Heating and Ventilating Magazine

VOL. V No. 3

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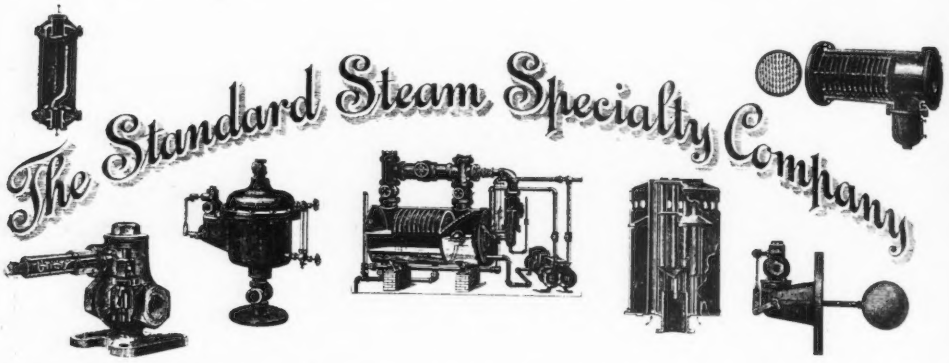

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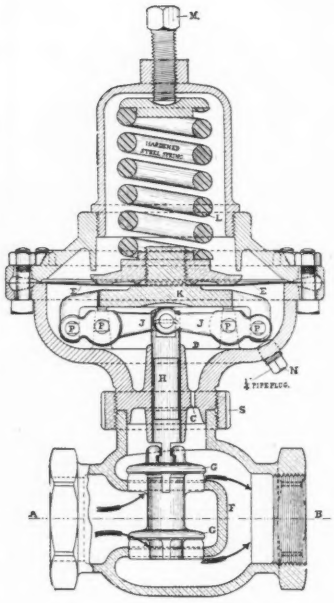

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK MARCH, 1908

Comparative Tests of Tubular Boiler Settings for Chicago Public Schools

An interesting series of boiler tests has recently been concluded in Chicago to determine the relative evaporation and combustion efficiency of two types of boilers, one equipped with the "Waters" setting, designed by T. J. Waters, chief engineer of the Board of Education of Chicago, and the other equipped with a setting designed by Paul P. Bird, chief smoke inspector of Chicago. The results of the tests appear to demonstrate the superiority of the "Waters" setting.

The tests were the result of the action of the city smoke inspector in refusing to issue permits to contractors for the installation of steam heating plants in the Chicago public school buildings on the ground that the boiler settings did not meet with his approval and were not in compliance with the city smoke ordinance. After several conferences an appropriation of $500 was made by the Board of Education to be used in making evaporative and smoke tests at the Folsenthal School building.

No. 1 boiler at this building was equipped with the fire-brick enclosed furnace as designed by the smoke inspector, and the setting of No. 2 boiler, designed by Chief Engineer Waters, was allowed to remain intact.

The tests were conducted by Messrs. Collins & Stevens, expert engineers, January 2 and 3, 1908. The firing on the first day was conducted by a representative of the City Smoke Bureau and on the second day, under the direction of engineers of the Board of Education. At the suggestion of the City Smoke Inspector two other tests were made January 11 and 12, when the firing was conducted entirely by the regular firemen of the plant. The two series of tests showed little difference in the results obtained.

OBJECTS OF TESTS

The objects of the tests were to determine the following points:

1. Ability of the two boilers to economically carry the loads as required in the average daily operation of the school.
2. Relative amount of smoke produced.
3. Relative efficiency, economy and capacity of boilers.
4. Practicability and economy in operation of the two settings.

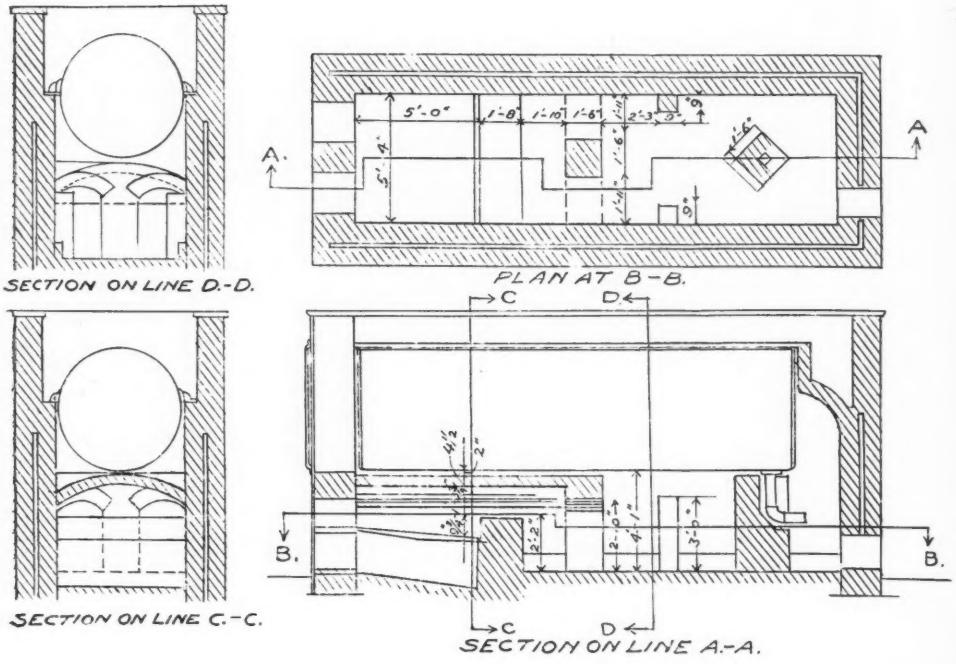
CONDITIONS

Both tests were run under nearly identical conditions as to outside temperatures. Tubes of both boilers were cleaned before starting the tests. Coal was of the same quality.

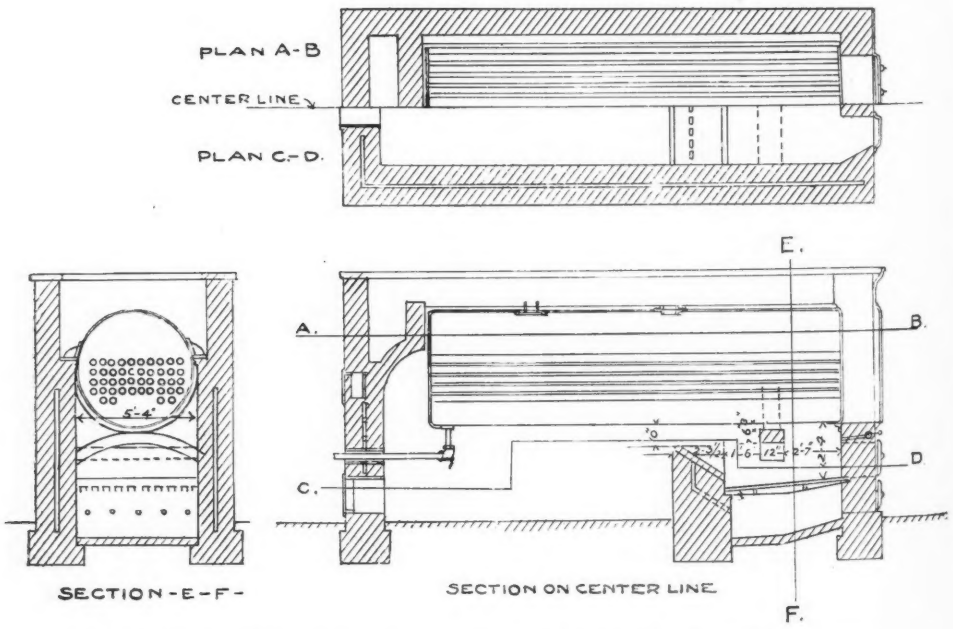
Water and coal used in the two tests were measured or weighed. Reading of pressures, temperatures and other data were taken at frequent intervals.

Blow-offs, cross connections and all possible chances for leakage were either broken or blank flanged.

The amount of fuel required to raise steam in the two boilers and the time required were noted. Evaporation tests were started after steam was raised.



PLAN AND SECTIONS OF 60 IN. x 18 FT. BOILER, WITH SETTING AS INSTALLED BY THE DEPARTMENT OF SMOKE INSPECTION OF CHICAGO



PLAN AND SECTIONS OF 60 IN. x 18 FT. BOILER WITH "WATERS" SETTING

Firing on the first test was conduced by a representative of the City Smoke Bureau and on the second test firing was under the direction of engineers of the Board of Education.

It was the intention to run both tests under as nearly identical conditions as could be obtained and to provide every facility for the operation of each type of setting to its best advantage.

In the tests conducted January 11 and 12 the firing, as stated, was conducted by the regular fireman of the plant. Otherwise there was no material change in the conditions.

SUMMARY OF PRINCIPAL RESULTS OF TESTS

The following is a summary of the principal results developed in the tests:

	Firebrick Enclosed Furnace	"Waters" Setting.	Firebrick Enclosed Furnace.	"Waters" Setting.
Date of trial	Jan. 2	Jan. 3	Jan. 11	Jan. 12
Temperature of water in boiler			194° F.	140° F.
Fuel required to raise steam.				
Wood	75 lbs.	75 lbs.	100 lbs.	100 lbs.
Coal	1200 lbs.	800 lbs.	650 lbs.	475 lbs.
Time required to raise steam	1 hr. 45 min.	1 hr. 25 min.	53 min.	1 hr. 6 min.
Efficiency of boiler and grate	57.75%	64.82%		
Evaporation per lb. of coal, actual	5.405	6.189	4.985 lbs.	5.638 lbs.
Evaporation per lb. of coal from and at 212° F.	6.503	7.463		
Cost to evaporate 1000 lbs. feed water	18.50c	16.16c	20.06c	17.73c
Horse power developed	117.8	104.1	96	94
Smoke	———	———	Slight	Slight

SMOKE

During the first hour of both of the first two tests, the smoke emitted was considerable for a short interval immediately after firing. In neither case was very black smoke given off for more than a few seconds.

On the remainder of the first two tests, the "Waters" setting was operated with very little smoke at any time. The condition of the stack was somewhat better on this part of the run than the performance of the firebrick enclosed furnace.

CLEANINGS

It was necessary to clean the fires three times during the first two tests of the firebrick enclosed furnace against one cleaning of the "Waters" setting. This cleaning was the cause of a considerable loss of efficiency and also was conducive to the production of smoke as well as being of serious consequence in the reduction of the steam pressure to a point where it was necessary to shut down the engine.

Following are tabulated data taken from both series of tests and the calculations therefrom:

DATA OF TESTS

	Firebrick Enclosed Furnace.	"Waters" Setting.	Firebrick Enclosed Furnace.	"Waters" Setting.
Kind of fuel	Miami	Miami	Miami	Miami
Kind of boiler	Tubular	Tubular	Tubular	Tubular
Date of trial	Jan. 2	Jan. 3	Jan 11	Jan. 12
Duration of trial, hours	8	8	8	8
Grate surface, sq. ft	27.0	27.0	27.0	27.0
Water heating surface, sq. ft	1200 (Note)	1200	1200	1200
Ratio of water heating surface to grate surface	1:44.4	1:44.4	1:44.4	1:44.4

(Note. No deduction was made for heating surface cut off by arch.)

	Firebrick Enclosed Furnace	"Waters" Setting.	Firebrick Enclosed Furnace.	"Waters" Setting.
	Average Pressures.			
Steam pressure, corrected, lbs. . .	30.1802	37.4	45.6	46.15
Atmosphere by barometer, ins. of mercury.	29.46	29.55	29.30	28.70
Force of draft in breeching, ins. of water.	0.503	0.477	.41	.30
	Average Temperatures.			
Of steam corresponding to pressure, deg. F.	274.0	283.4	292.8	293.4
Of feed water entering boiler, deg.F	35.5	36.0	35.5	35.5
Of escaping gases in breeching, deg. F.	386.2	373	508	443
Of outside air, maximum, deg. F.	37	41	39.0	33.0
minimum, deg. F.	25	26	35.0	32.0
average, deg. F. . .	32.3	34.6	37.1	32.8
	Fuel.			
Weight of coal as fired, lbs.	5000	3850	4400	3800
Percentage of moisture in coal. . .	12.15	9.50	8.57	8.33
Weight of dry coal consumed, lbs.	4392	3484	4023	3484
Weight of ash and refuse, lbs. . . .	765	587	610	502
Percentage of ash and refuse in coal.	15.3	15.2	13.86	13.21
Weight of combustible consumed, lbs.	3627	2897	3413	2982
	Analysis of Fuel.			
Percentage of moisture.	12.15	9.50	8.57	8.33
Percentage of volatile matter. . . .	32.24	32.18	33.20	33.05
Percentage of fixed carbon.	44.33	47.92	44.42	44.02
Percentage of ash.	11.28	10.40	13.71	14.60
British Thermal units, per lb., as fired.	10877	11120	10837	10894
British thermal units, per lb. dry coal.	12382	12288	11853	11884
British thermal units, per lb. combustible.	14205	13882	13736	13915
	Fuel per Hour.			
Coal fired, lbs.	625	481	550	475
Dry Coal, lbs.	549	435	503	435
Combustible, lbs.	453	362	427	373
Dry coal per sq. ft. of grate surface, lbs.	20.3	16.1	18.63	16.11
	Water.			
Weight of water fed, lbs.	27026	23829	21936	21427
Factor of evaporation, lbs.	1.2032	1.2058	1.2091	1.2093
Equivalent water evaporated from and at 212° F, lbs.	32517	28733	26523	25912
	Water per Hour.			
Water fed, lbs.	3378	2978	2742	2678
Equivalent water from and at 212° F., lbs.	4064	3592	3315	3239
Equivalent water from and at 212° F. per sq. ft. of water heating surface, lbs.	3.38	2.99	2.76	2.70
	Horse Power.			
Rated horse power at 12 sq. ft. . .	100	100	100	100
Horse power developed.	117.8	104.1	96.1	93.9
Percentage of rated horse power developed.	117.8	104.1	96.1	93.9

Evaporation.

	Firebrick Enclosed Furnace	"Waters" Setting.	Firebrick Enclosed Furnace.	"Waters" Setting.
Water fed per lb. of coal as fired, lbs.	5.405	6.189	4.985	5.639
Equivalent water from and at 212° F. per lb. of coal, as fired, lbs.	6.503	7.463	6.028	6.819
Equivalent water from and at 212° F. per lb. of dry coal, lbs.	7.404	8.247	6.592	7.437
Equivalent water from and at 212° F. per lb. of combustible, lbs.	8.965	9.918	7.771	8.689

Efficiency.

Efficiency of boiler, including grate, %	57.75	64.82	53.72	60.45

Cost of Evaporation.

Cost of fuel per ton of 2,000 lbs.	$2.00	$2.00	$2.00	$2.00
Cost of fuel to evaporate 1,000 lbs. of feed water under observed conditions, cents	18.50	16.16	20.06	17.73
Cost of fuel to evaporate 1,000 lbs. of water from and at 212° F., cents	15.38	13.40	16.58	14.67

Smoke Record.

From fourteen observations taken by representative of city smoke department.

10.08 A. M. to 4.47 P. M., total percentage, 47.75

9.53 A. M. to 4.32 P. M., total percentage, 54.05

The above figures show that there was very little smoke from either setting and is confirmed by observations taken at intermediate periods.

Coal, Ash and Water Record.

Coal, total, pounds	5000	3850	4400	3800
Total net water evaporated, lbs.	27026	23829	21936	21427
Ash and refuse, lbs.	765	587	610	502

(Ash contained a high percentage of unburned coke.)

Gas Analysis, CO_2, Percentage.

Jan. 2		Jan. 3		Jan. 11		Jan. 12	
12.45 P. M.	9.8	1 P. M.	10.0	4.10 P. M.	5.7	3.00 P. M.	7.0
3.00 P. M.	9.9	2 P. M.	7.1	4.20 P. M.	7.8	3.30 P. M.	7.8
4.00 P. M.	6.0	3.45 P. M.	10.1	4.45 P. M.	8.1	4.15 P. M.	8.1

Average Figures from Boiler Room Log.

Steam, lbs.	30.18	37.4
Draft, inches	.502	.447
Temperature, deg. F.	386.2	373.
Boiler room temperature, deg. F.	60.6	63.0

In neither case would it have been necessary to shut down school for lack of steam. The smoke in neither case was objectionable at any time. Both settings smoked somewhat during the first hour of the second series of tests.

Results show that about 175 lbs. more coal were required by the firebrick enclosed furnace to produce steam at the start in the second tests. This heat was no doubt absorbed by the brick work to be given off gradually after the plant was shut down.

In summing up the results of the tests Chief Engineer T. J. Waters, in his report, says:

"The conditions of the second test were more nearly those which would be met with in actual practice.

"The first test was started with both boilers and setting cold, and this gave the 'Waters' setting a large advantage, which may be noted in table by the increased amount of coal required to raise steam, with firebrick furnace.

"In the second test, the firebrick enclosed furnace had the advantage at the start, as the water in the boiler was 194° F. as against 140° F. in the 'Waters' setting. With 54° F. to its credit the firebrick furnace still took considerable more coal to raise steam."

The Operation of a Modern Heating and Ventilating System

Information and Instructions on the Heating and Ventilation of the New York City Public Schools. Published by the New York City Board of Education

No one knows better than the designing engineer of a heating and ventilating system how much the success of the plant depends upon its proper operation. In the hands of an incompetent or careless operator or interfered with through the action of principal or teachers, the most perfect system imaginable will fail to do its work.

Realizing the importance of this matter, the committee on buildings of the New York City Department of Education has issued a circular of information and suggestions, by Mr. C. B. J. Snyder, the chief architect of the department, which has been placed in the hands of those directly concerned in the regulation of the heating and ventilation of the city's school buildings. Following are the principal points brought out in the circular:

EFFECT OF BAD AIR

Chemical analysis of the air of rooms to determine the standard of purity is not always necessary, for reliable dependence may be placed upon an acute sense of smell.

The reason for this appears quite clearly in the statement of Dr. R. S. Tracy, Sanitary Inspector of New York, that:

"Beside the carbonic acid, there is exhaled from the human lungs a small amount of organic matter of unknown composition. It forms a glutinous coating on the furniture, walls and windows of closed rooms, decomposes rapidly, imparts a peculiarly offensive odor to the air of the badly ventilated room, and poisons those who inhale it. Its quantity is so small that it has so far defied analysis."

Another authority states that "the impurity in the air which it is desirable to get rid of is the organic matter given off from the skin and lungs, and matter detached from the skin and mouth, and are partly of an organic vapor from the lungs and mouth."

It is impossible, after reading these two statements, to plead ignorance as to what causes the close, fœtid smell of an unventilated school room or to ignore the necessity for ventilation.

Of this, Prof. S. H. Woodbridge, of the Massachusetts Institute of Technology, Boston, says:

"The evil effects of lack of ventilation are made only too evident by such facts as that 'death rates have been reduced by the introduction of efficient ventilating systems, in children's hospitals, from 50% to 5%; in surgical wards of general hospitals, from 44% to 13%; in army hospitals, from 23% to 6%. . . . Prison records show reduced death rates, chiefly as the result of effective ventilation, in one case from the yearly average of eighty deaths to one of eight, each period covering the same and a considerable number of years. . . . The annual death rate among horses in army stables in the German service has been reduced by more roomy quarters and free ventilation from 19 to 1.5, and in a time of epidemic in Boston the number of horses lost in badly ventilated stables was five to one in those well ventilated.'

"While such figures show directly traceable results of breathing impure air, it is not in these most serious consequences alone that its evil effects are revealed. A vitiated atmosphere lowers the vitality, increases the susceptibility to and severity of disease, and decreases the physical and mental working power of the individual, and, while not producing sudden death, nevertheless inevitably shortens life."

It is a well-known fact that the teacher and pupils do not realize the increasing impurity of the air in the unventilated room until the air is so

bad that a person coming from the atmosphere of out of doors or even from the corridor is apt to be nauseated on entering the room.

REPORT ON NEW YORK PUBLIC SCHOOLS

In his recent report made to the Building Committee of the Board of Education of this city, Prof. Woodbridge, who was called upon to make an investigation of the heating and ventilating of our schools, says:

"In general, the methods employed for both warming and ventilation in the several cases examined have been found to be correct and in accordance with the most approved modern practice.

"Unquestionably far more effective ventilating work might be done by the old, simple and natural method of perflation by open windows and doors, that is, by allowing the winds to blow through the school building, than is obtainable by modern artificial methods of ventilation; but, because of uncomfortable and dangerous draftiness, and of unavoidable coldness not infrequently attending such draft, and because of the extreme irregularity of the action of the perflation method, and also because of the cost incident to providing means for properly warming a sufficient quantity of air to provide adequate ventilation secured by that method, resort must necessarily be had to artificial ventilation by an internal system of supply, warming, distributing and discharging air for ventilating purposes.

"The causes of such complaints as may be lodged against unsatisfactory atmospheric conditions within schoolrooms in the class of buildings thus far examined are to be found, not so much in radical defects in the method of ventilation employed, or in any markedly inadequate provision for ventilation, as, first: in the severe restrictions imposed on sanitary work and hygienic conditions by limitations in building space; and, second: in the illegitimate functions* which popular judgment imposes on ventilating work, a judgment commonly shared by the users of schoolrooms and by the public at large."

*Referring to cleansing, which should be done by use of bathtub and laundry.

There is some slight change of air in a room that is heated, due to leakage around doors and windows, and if the room be large and the leakage great there may be a sufficient supply of fresh air for one or two people, as with a difference in temperature between the room and that out of doors of 35°, the air in an outside room will be changed about once an hour.

EFFECT OF OPENING WINDOWS

The rapidity with which the air in a room may be changed by the use of windows is dependent almost entirely on the difference in temperature and the pressure of the wind due to its velocity.

Taking a school building, for example (without artificial ventilation), of the familiar type, with rooms on each side of a corridor, it will be found, with a strong wind blowing against the windows on one side, that even with these windows open there will be no outward flow of air, but that the draft will be across the corridor and into the rooms on the lee side, thus reducing the purity of the atmosphere in these rooms through the presence of that already breathed in the rooms on the windward side.

It has been clearly demonstrated also that fresh air will not enter a room through open windows on one side of a room, unless there is a considerable difference in temperature between that in the rooms and out of doors.

One of the greatest sources of trouble is the overheated room, due to lack of heat control, either automatic or manual, the first usually omitted in unventilated classrooms because of the cost, and the second due to the absorption of the teacher in her work until the temperature often reaches 80° or more, when, if attention be called to it in some manner, the windows will be thrown up from the bottom and pulled down from the top.

The result of this on even a quiet day with, say 12° of frost and cold, is interesting. It will be found that the superheated air next the ceiling will pass out through the opening made by the lowering of the upper sash, the air in the room rising to fill its place, while the cold air comes pouring over the window sills of the open windows, dropping to the floor like so much cold water, lowering the temperature of the air about the children's feet with astonishing rapidity, until, in about ten minutes, the temperature at the floor level of the room near the windows will be just above freezing, while that at the level of the children's heads may be 65° or even 70°, differing with the position of the pupil with relation to the open windows.

Curiously enough, the position of the teacher in the room usually makes her unaware of these alarming atmospheric conditions.

MECHANICAL VENTILATION IN CLOSED ROOMS SATISFACTORY

This overheating of a room also occasions many complaints of lack of ventilation, of closeness, stuffiness, oppressiveness, etc. This occurs at times in rooms where each pupil is being supplied with over 30 cu. ft. of fresh air per minute and provision made for the removal of the foul air, but it is due entirely to overheating, something which it is the duty of both teacher and janitor to prevent, as it can be easily controlled by them.

It is conceded that some means must be provided for the ventilation or flushing with fresh air of the unventilated schoolroom, and it is thought that this may be accomplished by teachers occupying such rooms to set aside a few minutes at the expiration of a half hour period to open doors and windows, meanwhile putting the pupils through some rigorous exercise. Artificial or mechanical ventilation renders this unnecessary.

That part of the report of R. C. Carpenter, professor of mechanical engineering of Cornell University and a well-known expert on heating and ventilation, covering these points, is as follows:

I enclose with this letter a report of a series of tests made by Prof. H. Diederichs, at my request, of the character of the ventilation in two of the New York City schools. In one school building where the ventilation was tested, air for ventilation was supplied by a blower, the air being heated up to a temperature of about 70° before entering the room. In the other building the ventilation all depended upon the air which could be obtained from the open windows and the discharge through certain vent ducts which were connected at the upper and lower part of the room.

The general results of the tests show that in the building with mechanical ventilation the air remained good with all the windows closed so long as the blower was running. In the rooms which were not supplied with mechanical ventilation, it was found that fairly good ventilation was secured so long as the windows could be kept open; but with the windows closed the air become distinctly bad in fifteen minutes in all cases, and, in some cases, became positively unbearable. An investigation indicated that the ventilation by opening windows was of uncertain character when the weather was cold or stormy, although on the day in which the test was made, the outside weather being favorable, good results were obtained from opening the windows.

In making the test to determine the character of ventilation, the air of the schoolroom was analyzed to determine the amount of carbonic acid (CO_2) present. Determinations of the temperature and moisture in the air were also made. The amount of CO_2 in the air is an index of the character of ventilation, since any increase over the normal amount which is found in pure air is due to the products of respiration and indicates a contamination of pure air with that which has been breathed. Pure air normally contains 3 to 4 parts in 10,000. It is quite impossible to re-

move from any inhabited room all traces of the air which has been previously breathed, because of the rapid diffusion of the entering pure air with that already in the room, and for that reason a standard of contamination which denotes the good air from the bad air has been arbitrarily adopted corresponding to about 8 parts of CO_2 in 10,000, or to about double that which is found in pure outside air.

In the mechanically-ventilated school the air was found to carry from 4 to 8 parts in 10,000 in all the ventilated rooms, as appears on the table giving the summary of tests. In three rooms in that same building, not provided with mechanical ventilation, the results were extremely varied. For instance, in the principal's room the determination, both forenoon and afternoon, showed quite pure air. In room 305, which contained 37 pupils, the air was extremely bad, the CO_2 in 10,000 running up to 15.5, or about 4 times that contained in normal air. In room 105 of the same building, not supplied with mechanical ventilation, the parts of CO_2 ran up to 11 in 10,000, indicating a contamination which certainly cannot be healthy. In making the two determinations referred to last, the windows were closed for only fifteen minutes previous to making the determination; hence the results indicate that window ventilation is absolutely necessary in these rooms, and that, if the windows were not opened, the air would soon become extremely unsanitary and nearly stifling.

TESTS IN BUILDING WITHOUT MECHANICAL VENTILATION

In the school building without mechanical ventilation, which I have termed in the table "gravity ventilated school building," tests were made in most of the rooms with the windows open, as they were found when entering the room, and after the windows had been closed fifteen minutes. The results of this test indicate that when the windows were open good ventilation was secured in practically every case, with the exception of room 26, on the third floor. With the windows closed for fifteen minutes, the air in all cases was distinctly bad, and in some cases very bad, the amount of CO_2 in 10,000 varying in the different rooms from 9 to 13.5 parts. Nearly all of these rooms had flues connected with the outside air and these flues were open at the time the windows were closed without in any case producing any sensible results in maintaining the air pure, although in some cases the air was discharged from these flues with a strong velocity. In most cases the velocity of the air discharged through the flues leading upward from the room was much lessened by closing the windows and in many cases entirely neutralized. In the case of room 13, on the top floor, there was a strong downward draught of air into the room when the windows were open, which disappeared and partly reversed when the windows were closed. This was doubtless caused by an induced air current passing through the room with the windows open.

Investigation indicates that with mild and fair weather good ventilation can be secured by open windows under the conditions common to those in the school building investigated, in which the rooms are of small size and exposed on one or more sides to the outside air. Such ventilation is, however, not practical, when the outside air is cold, without a great loss of heat, and the testimony of the teachers indicated that the air became sensibly very bad in such rooms when the weather outside was cold or stormy.

The effect of closing the windows in the gravity-ventilated school building was in all cases to raise the temperature of the rooms rapidly and to some extent increase the amount of moisture contained in the air. The increase of moisture probably being due to the same cause as the increase of carbonic acid, that of respiration, hence it is also to be considered as an index of contamination under the

special condition which produced it. The feeling of discomfort which is due, in part, to the impurities of the air, and which was specially noticeable in the rooms where the windows were closed, was due principally to the rise in temperature above the normal. For instance, in some cases, where the normal temperature had been maintained at 70°, it rose to 75° after the windows had been closed for fifteen minutes, and this high temperature, together with the increased impurity in the air, made the quality sensibly bad.

While this investigation was not taken at a time of the year when the heating system was in full operation and when we could observe its operations under maximum conditions, I am led, however, to believe, from such investigations as I could make and also from certain computations, that an excess of heating surface is supplied over what would be necessary under conditions where window ventilation is not employed; and this again leads to the conclusion that, in cases where window ventilation is employed, an excess of coal must be

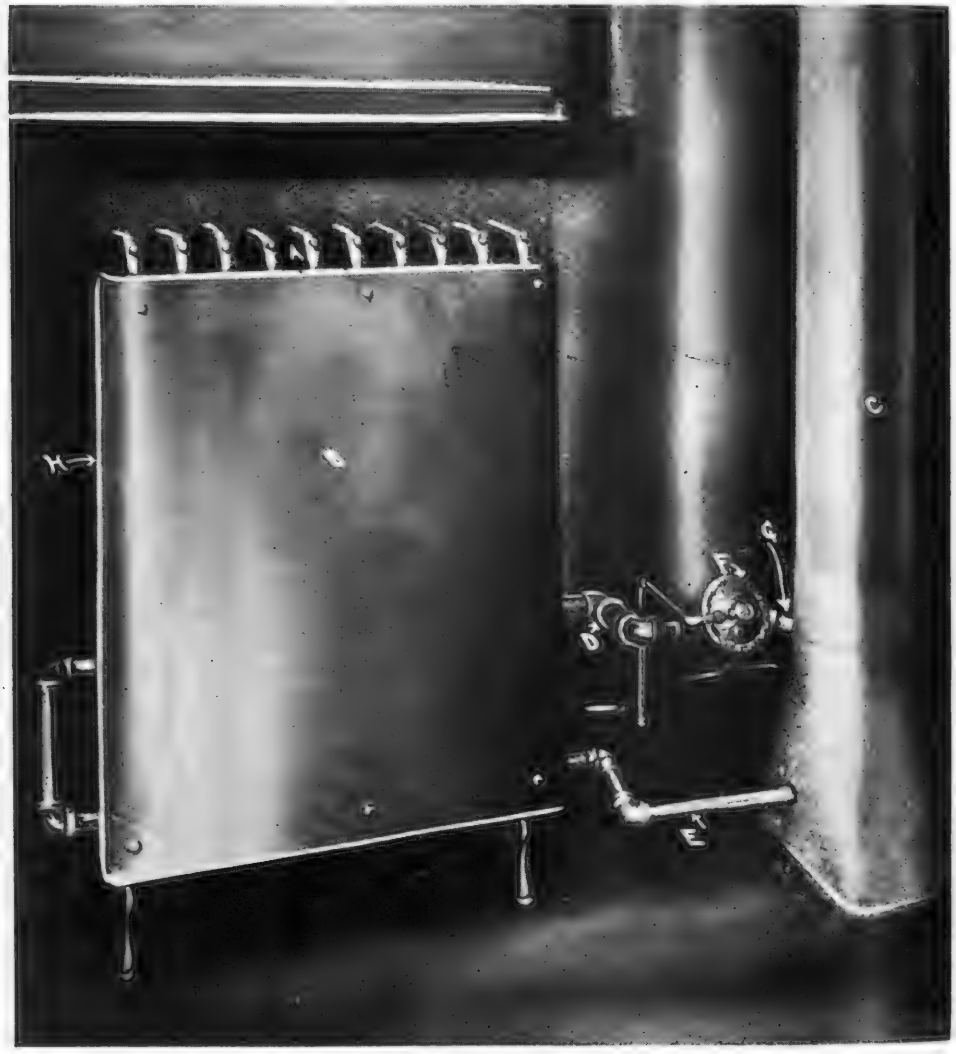


FIG. 1.
A—Radiator. B—Screen. C—Riser (encased). D—Steam connection to radiator. E—Return from radiator. F—Thermostatic control valve to automatically turn the steam on and off according to the temperature of the room. G—Hand valve is inserted here on alternate radiators in new schools. H—Automatic air valve concealed by screen.

burned to keep the building warm as compared with those cases where mechanical ventilation is employed and window ventilation not needed.

Investigation indicates, in short, that the system of mechanical ventilation now employed in connection with direct radiation in which the air is introduced in the side walls near the upper portion of the room and discharged from ducts in the side walls, near the lower portion of the room, produces good results so far as ventilation is concerned.

Second, in school buildings which are not provided with blowers, ventilation must be maintained with open windows in order to provide good ventilation; and this can only be done with large waste of fuel during cold and unfavorable weather.

UPWARD SYSTEM HAS LIMITED USES

The question of the use of an upward system of ventilation, instead of the semi-downward system now in use, has, I believe, received consideration from the committee of the Board of Education, and also from your heating and ventilating engineer. In my opinion, such a system could only be applied to the small rooms and low ceilings which characterize most of your classrooms only by great expenditures of time and money. This system would require chambers underneath the floors and large areas of floor registers, which are incompatible with your present building construction. It appears from the tests, which are submitted in connection with this report, that the present system of mechanical ventilation gives good results, and, so far as ventilation is concerned, is not, when kept in proper working condition, open to criticism. This system is comparatively cheap to install, is thoroughly practical with your present system of building, and whether or not better results would be produced by a system other than upward ventilation, could only be decided by an expensive system of experiment and trial.

"My own opinion is that an upward system of ventilation would not produce superior results than those you are now getting, so far as ventilation is concerned, except in the auditoriums with balconies and lofty ceilings, which are now used for only a short time each day, and in which the present system gives fairly satisfactory results."

Careful examination of the various systems designed by engineers of this and other large cities leads to the conclusion that the combined direct heating and plenum ventilating system, as installed in our later constructed schools, is the most flexible, adequate and economical of any system yet devised.

This conclusion is borne out by the reports of Prof. R. C. Carpenter and Prof. S. H. Woodbridge in their recent reports to the Committee on Buildings. As this type of system is being installed in all new and altered buildings, except in rare cases, the following description is necessary:

HEATING SYSTEM INSTALLED IN NEW YORK SCHOOLS.

The heating is entirely distinct from the ventilation, which is of the mechanical type, and each, therefore, will be considered separately. The heating is by means of direct radiation, where the air of the rooms comes into direct contact with the heated surfaces of the radiators. Fig. 1 illustrates the usual type of cast-iron vertical loop radiation, the front projected by means of a screen.

The other type is known as a wall coil and consists of wrought iron pipe made up into such form and dimensions as will suit the requirements. (Fig. 2).

The radiators of either type are placed along the cold walls of a room, usually under the windows, and heated by steam at a pressure not exceeding 10 lbs. per square inch.

As before mentioned, one of the greatest sources of trouble is the overheating of the schoolrooms, resulting in distress, illness and waste of fuel. It is readily understood that the teacher with 40 or 50 pupils has something else in hand than to watch the thermometer, and as in 99% of

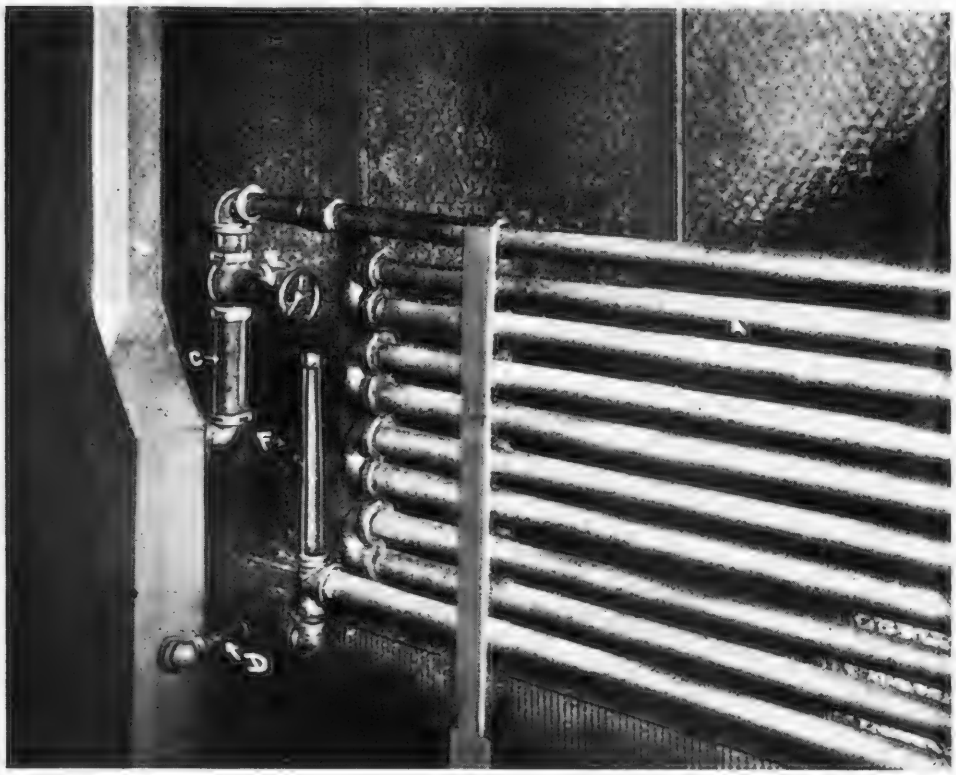


FIG. 2.

A—Coil. B—Riser (encased). C—Steam connection to coil. D—Return connection from coil. E—Hand valve to control steam to coil. F—Air valve (automatic in action).

Note.—Coil in this cut is shown in hall. Classroom coils similar with the thermostatic valve F and screen B added, as shown on radiator, Fig. 1.

the cases that is the only real determining factor as to temperature, overheating is bound to occur, and from this extreme it is, as before explained, but a ten minutes interval to the other, that of an illy warmed room.

USE OF THERMOSTATS

Expert inventors have been at work many years to overcome this by means of the introduction of some automatic control, relieving the teachers entirely of all thought on the subject. The instrument designed for this purpose, the thermostat, has been worked out in many forms, one of the difficulties having been to connect it with some flexible motive power which would operate the valves at any desired point. The best results have been obtained through the use of compressed air, the supply to the valves, (F, Fig. 1) being controlled by the thermostats themselves, which are placed in a convenient point on the wall and which are set so that when the temperature in the room reaches the desired point (usually 70° F.) steam is turned off the radiators, and when the temperature drops to 68° the steam is permitted to again enter the radiators, the intent being to maintain the temperature between 68° and 70° F.

Personally, the writer is of the opinion that we are proceeding on the wrong basis, i. e., 70° F. is altogether too warm, and that the thermostats should be set so as to maintain a temperature of not more than 68° F. for the schoolroom.

Another source of complaint is overheating due to the alleged nonworking of the thermostats. Take a case, for instance, where the temperature has arisen to 72° or 74° F. and the janitor or engineer is sent for. He finds that the thermostat per-

formed its work when the point of 70° was reached, but that the mere shutting off of the steam at the valve of the radiator will not, in a minute, cool it down so that it will no longer give off units of heat. On the contrary, the huge mass of metal in each radiator (sometimes there are two or three radiators in one room), continues to give off heat until the air of the room has cooled it off and condensed the steam which it contained. This sometimes requires the better part of an hour.

Often overheating is caused by the rays of the sun on the windows, and with the valves on all radiators closed the temperature is liable to increase beyond the point of comfort.

Again it is almost impossible to keep the temperature low enough for comfort in schoolrooms when that in the hallways is at 80° to 90° F., a very common occurrence, but one easily avoided if the janitor would but shut off the steam by closing the valves provided for the purpose.

As a matter of fact there are not

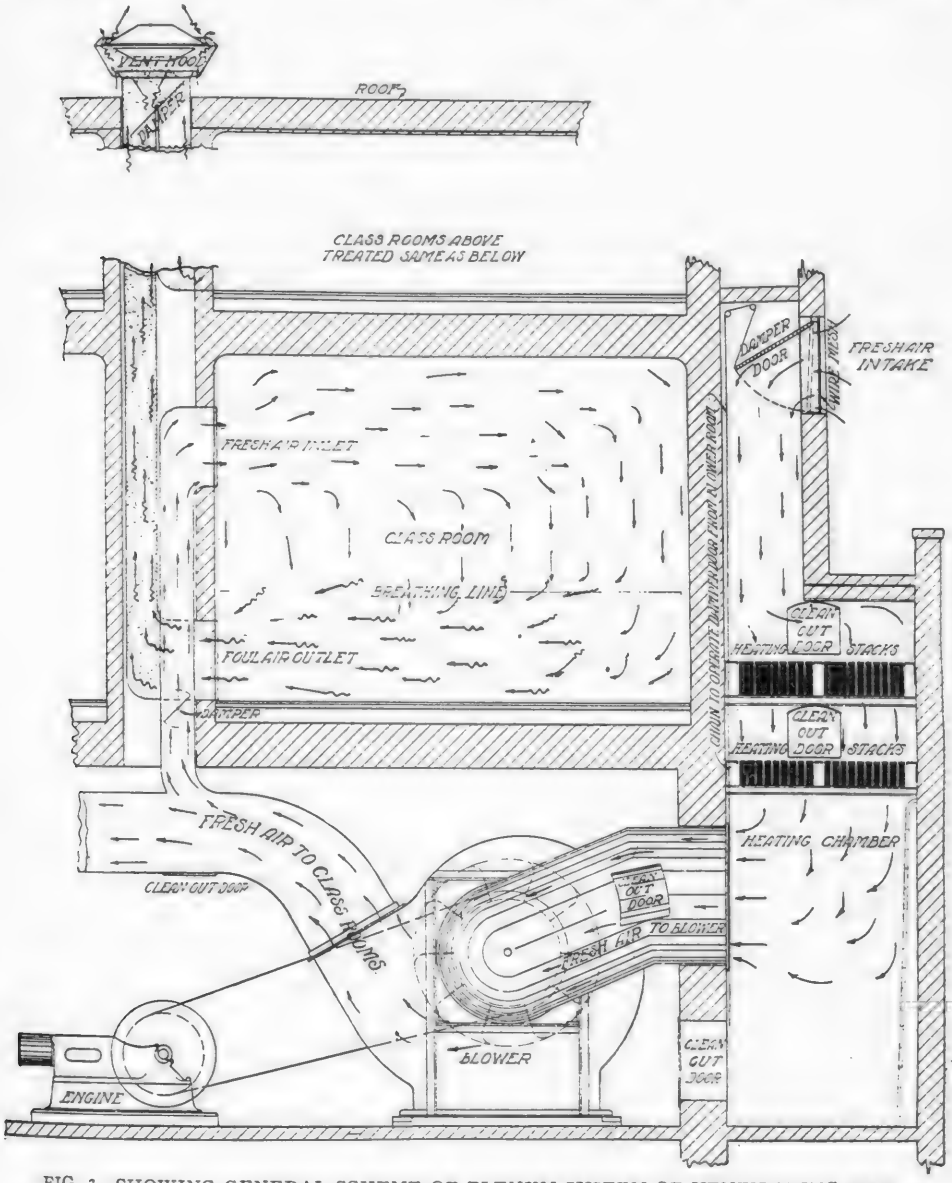


FIG. 3—SHOWING GENERAL SCHEME OF PLENUM SYSTEM OF VENTILATING NEW YORK CITY'S PUBLIC SCHOOL BUILDINGS.

more than ten days during the entire winter when heat is needed in the hallways of most of the newer buildings, but there are not ten days during the winter when they are shut off as they should be.

DESCRIPTION OF VENTILATING SYSTEM

The so-called plenum system of ventilation which we use is illustrated in Fig. 3.

Air from out of doors enters the fresh air intake, located at some distance above the level of the ground, thence passing downwards, coming in contact with the heating stack, which warms it to about the temperature of 70° F., from which it is conducted into a centrifugal blower run by a steam engine or electric motor; thus sufficient velocity is imparted to the air to force it through tight galvanized iron ducts to each classroom.

Here the fresh air is admitted to an elevation of 8 ft. or 10 ft. from the floor, passes across the room and downward, is breathed by the pupils, drops to the floor, as it were, and passes on to the vent flue, where it is conducted up and out through special vent caps at the roof to the outer air.

A rather unpleasant proof that this method carries off the bad air of the classrooms is evidenced by the numerous instances when workmen engaged in some repairs about the vent flues on the roofs during school hours have been overcome or made ill by the effluvia which pour out as long as the rooms are occupied and blowers are in operation.

The purity and freshness of the air drawn in by the blowers are assured by taking this air directly from out of doors and as high above the ground as practicable. No air is drawn from the cellar, nor is the air taken from the neighborhood of toilets or vent outlets or other sources of possible contamination.

To insure distribution of the fresh warmed air which is delivered into the room through wire screens or registers placed on side wall near the ceiling, to all parts of the room, some form of "diffuser" or "deflector" is usually placed in front of the inlet screen. These deflectors are adjusted to perform certain work and should not be changed by teachers or other unauthorized persons, as the proper supply of air can only be had when the deflectors are properly placed. In Fig. 3 these diffusers are omitted for the sake of clearness.

The outlets for escape of vitiated air placed in side walls near floor, or in floor, are also provided with wire screens or registers. Formerly a second vent register, with valves operated thermostatically, was placed near ceilings to allow the escape of warm air if room became overheated. This, however, was found to allow the purest air in the room and the incoming fresh air to escape without reaching the children, and thus they were left without any appreciable fresh air supply; therefore, those heretofore installed have been closed and fastened in all cases and should not be used.

It is very important that no teacher or pupil should sit nearer than 2½ or 3 feet from a vent outlet, as the movement of air towards and through the outlet is usually rapid enough to create the feeling of sitting in a draft.

It is also recommended that each teacher insist on having a narrow ribbon about 15 in. in length tied to the fresh air inlet screen near the top. When blowers are run this ribbon will show the incoming of fresh air, being supported at about 30° to 60° away from the screen. A check may thereby be kept upon the running of the ventilating system by the janitor.

The amount of air delivered to each room is carefully tested and determined by the use of an anemometer which accurately measures the flow of air, and by adjusting dampers in the flue supplying each room the proper amount of fresh air is given to each room.

In public schools we allow a minimum of 30 cu. ft. of fresh air per minute for each pupil and allow for 50 pupils in each primary and grammar school room and for 35 to 40 pupils in each high school room.

HUMIDITY, DUST, ETC.

The air sent up to the classrooms by the blower is really purer than the out of door air and is as moist as the air coming in through the windows and heated to the room temperature. Both have the same amount of moisture when out of doors, and as no moisture is deposited on the indirect radiators or in the ducts, the air passing through the ducts must still have the same weight of water in it that it held when taken from outside. It is true that the room air is relatively drier than out of door air, as one pound of air at 70° F. occupies more space than one pound at 0° F., and, consequently, will hold much more moisture and will be relatively drier with the same moisture that it held when cold.

It is not possible to have the air in a room at 70° as fully saturated with aqueous vapor as the outdoor air at 0° F., as the glass and walls are nearly at the outdoor temperature and would cool the room air coming in contact with them below the dew point and water would be precipitated on the cold walls and glass, just as the cool water pitcher sweats in hot weather.

Experiments are being made with a view to overcoming the difficulties heretofore experienced in increasing the relative humidity of the air furnished for ventilation by means of the various devices, patented and otherwise, for washing and moistening the air, but none of which appear to have reached a stage of perfection and commercial adaptability warranting their general use.

It is a fact, however, that the air in our ventilated schoolrooms is not as dry as that in most modern buildings, particularly those heated by furnaces or stoves. The apparent dryness is not really a serious matter, as it is reported as conducive to the destruction of disease germs, bacilli, etc. The human "body smell," indicative of poisonous effluvia, is always more offensively pronounced in a humid atmosphere than in one that is dry.

The real trouble is that the sudden changing from the dry air indoors to the moist air outdoors and vice versa irritates the mucous membranes of the respiratory tract and causes a sensation of tickling, which is more annoying than serious.

The air coming through heaters and ducts is more pure than outdoor air because of the disposition of most of the incoming dust on the floors of the heating chambers, ducts, etc., the drier state being also unfavorable to growth of germs. Bacteriological tests by Prof. Woodbridge of dust taken from the floor of the long, underground fresh air duct supplying the Senate Chamber in Washington showed that the passage of the pure air over the dust had prevented growth of germs, so that it was harmless.

Inspection of ducts, fresh air inlets, etc., will almost invariably show that the air sent into classrooms by the plenum system is freer of dust than the air taken through windows at the same time would be. The dust most noted in classrooms is due to scuffling of feet, wear of clothing, dust from blackboard crayon and that brought into the room on shoes and clothes of the children.

The effects of opening the windows in a schoolroom while any form of mechanical ventilation is in operation is to render it of no value whatever.

There is only one thermostat in a room, so placed as to reflect its average temperature, but if a cold draught strikes it from an open window we have the anomaly of the steam being turned on to warm the room and the windows open to cool it, one offsetting the other and neither being effective, while the fresh air being supplied from the blower is short circuited out of the open window and the pupils will continue to breathe foul air.

The teacher, when the season for running the ventilator apparatus has come, should bear the following in mind

DON'TS FOR OPERATING VENTILATING SYSTEM

First—Don't delay in notifying the

principal if the ribbon in front of the fresh air inlet ceases to flutter.

The janitor is paid to run the ventilating apparatus during school hours.

Second—Don't fail to keep the room temperatures on the chart provided for the purpose by the supply department.

Attention to this is a check on occasionally permitting the room to become overheated.

Third—Don't permit the temperature to rise above 72° without notifying the principal.

This limit is set at the request of many teachers who fail to recognize that both their own health and that of the pupils would be far better if they had the limit fixed at 68° F., which the janitor can do on request.

Fourth—Don't permit the doors and windows to remain open while blowers are running.

If too hot or too cold, notify the principal, but be sure that the complaint is based on thermometer readings and not on personal impressions.

Fifth—Don't permit fresh air inlets to be closed off by having the louvres of the diffuser closed back against the register face.

Sixth—Don't permit the outlets to be closed off with paper or other material.

Seventh — Don't permit boxes, boards, books, papers, or other articles to be placed on the top of the radiators or fresh air inlet boxes, which in some schools are in front of the windows. They all obstruct the radiation of heat by checking the circulation of air through and around the radiator.

Eighth—Don't stick pins, flag staffs, sticks, matches or similar materials into the frame of the thermostats.

Many of the ventilating systems have been thrown out of order by this means, often caused by the insertion of something as a part of a scheme of decoration.

The trouble thus caused is sometimes enormous, as a mechanic must be sent to the building to test out every instrument until the defective one is located. This in a building with forty or fifty rooms is a serious matter.

Ninth—Don't find fault unreasonably.

Suggestions are also given for the direction of principals.

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*Warming and Ventilation**

By W. H. Casmey

The end and aim in applying a ventilating plant to any building is to make it breathe in unison with the number of people who occupy it. A building without ventilation is like a statue of a man, lifeless. Many of you have, no doubt, been struck with the beautiful mechanism of the human body so far as it relates to the air supply and the distribution of heat so that all parts are maintained at one constant temperature.

First the air either enters by the warm chamber of the mouth or by the nose, the inside of which has a convoluted appearance and may be compared to a hot water radiator. It is then passed along the warm air passages to the warming chamber which contains about 15 times as much air as we are able to take in at one inspiration, and even the deepest expiration cannot empty this chamber, as it is kept firm by hard rings of gristle. Another safeguard against cooling the blood is the speed at which it travels as it is only momentarily exposed to air.

Under normal conditions, the whole of the blood in the body is brought into contact with the air about once per minute, and the air

*From a paper read at the February, 1908, meeting of the British Institution of Heating and Ventilating Engineers and awarded second prize in the Assistants' Prize Competition, 1906-1907.

we expire may very well be considered as the smoke from a furnace chimney, as the laws of combustion apply in both cases.

The parallel goes still further. The thermostat of the body is fixed at 98°, and no matter, when in health, if surrounded by air at 20° or 200°, the temperature of the blood never varies. In the former case, deeper breathing is carried on which supplies more air to the body, and, therefore, more heat is generated, and in the latter case, the heat escapes through the sweat glands in the form of moisture.

The human body is then supplied with pure air, the oxygen of which, uniting with the carbon or waste tissues, generates heat, and the air leaving the lungs must therefore contain the products of combustion, carbonic acid gas, and also tiny particles of effete matter, which in still air very soon decompose and give off a most disagreeable smell, and the air so charged is more dangerous to breathe than sewer gas.

The need of ventilation will be better understood when we consider that in 24 hours an adult, in health, gives off through the lungs 11 ounces of carbon, nearly the same weight of watery vapor and the heat contained in the expired air (and given off from the surface of the body), is sufficient to increase the temperature of 5,000 cubic feet of air 25°, and further we lose from the skin in the same period of time over 1% of our total weight.

We all know the composition of pure air and that under normal conditions we pass through our lungs 15 cubic feet per hour, and the figures just given indicate the change which takes place during its passage through the system. If we are to keep the conditions of a room healthy, occupied by say 20 people, we must furnish ventilation in the proportion of 3,000 cubic feet per head, or a total of 60,000 cubic feet, a little over two tons per hour, of course assuming the outer air does not contain more than 1 part of CO_2 per 2,500 of air. If this is exceeded, the ventilation would require increasing accordingly.

It has been estimated by various authorities that through fitting up a factory with a scientific system of heating and ventilating, the turnover has increased over 5% per annum. The steam engineer never attempts to pass the products of combustion over his fires again, knowing the results would be disastrous, but the same man does not hesitate to breathe over and over again his own breath and that of others, and is surprised if the danger is pointed out to him.

The disease that is at present claiming the greatest attention in its air-borne aspect is tuberculosis. Not only in the acts of coughing and sneezing, but also in the act of loud speaking, fine droplets of mucus are sprayed from the mouth into the air. They float in the air, and may be wafted by the air currents, such as obtain in ordinary rooms, to a distance that appears at first sight to be almost incredible. Thus it has been shown that by reading aloud for half an hour, bacillus prodigiosus may be disseminated from the mouth to a distance of 24 feet in front, and may also be obtained from the air behind the speaker.

We will now briefly consider the various methods of ventilation, but first let us examine more in detail why ventilation is a necessity. The human system is a kind of slow combustion stove to which about 400 cubic feet of air (30 lbs.) must be supplied every 24 hours to carry on the burning up of the waste tissues of the body. This union generates heat. Without this supply of air, life would cease, or, in other words, the fire would go out. Ventilation, then, is to assist in creating heat, and warming our rooms is to conserve it. To dilute the 400 cubic feet of air mentioned, a supply of 72,000 cubic feet would be necessary. Therefore one person in 24 hours should have for ventilation a little over 2 tons of air.

FEATURES OF MECHANICAL VENTILATION

Mechanical ventilation may be divided into three sections: extraction, propulsion and a combination of both, which we will call the twin system.

Extraction ventilation is very largely used in all classes of buildings, and in many cases with great success. There is, however, always the danger of the air supply being secured from undesirable sources. It is no uncommon thing to find the suction of a chimney entirely nullified by a fan; such conditions may happen when the fresh air inlets have been inadvertently closed.

Again, with extraction, the danger of draughts from bad fitting doors or windows is very great, and there is, as a rule, great difficulty in securing an equal distribution of the fresh air, as the fan will always take its air supply along the line of least resistance, and often leaves other parts of the room unaffected. As an illustration of this, I have seen a dyehouse, 100 ft. long and 60 ft. wide, so charged with fog that it was impossible to see the workmen. At the far end of this dyehouse, a 6-ft. fan was fixed, the air supply of which was through the doorway at the opposite end of the building.

A few minutes after opening this door, the fan could be seen distinctly from the doorway through a circular passage, the full length of the dyehouse and about 7 ft. in diameter, whilst all other parts of the place were invisible. The moist air being lighter than the dry outside air, allowed the latter to pass through and form the circular passage referred to.

The success of a system of extraction very largely depends on the distribution of the radiators and fresh air inlets, but the attention required for keeping such a plant in perfect order is very great, owing to the many points where air filters are necessary. In isolated rooms where connecting flues to a main outlet fan is difficult, or may be impossible, the electric fan is of great service, and I believe in the lobbies and committee rooms of the House of Commons about 70 such fans are in use.

The propulsion system comes near to our first illustration (the human body), the whole of the air entering at one point where it is screened and warmed and then propelled along the main air duct from which branches are taken to the various rooms. This method, without modification, is, however, not suitable for a building of large area, as the loss of heat in passing the warm air from the heating battery makes an equal temperature in the various rooms next to impossible.

An improvement on this method is to have supplementary heating coils at various points in the main duct, these entirely remove the difficulty. The air should enter the rooms about 8 feet from the floor level with a velocity of say 5 feet per second, and the outlets should be on the floor line and near the ceiling, each fitted with a valve to enable the occupants of the room to vary the point of outlet as desired, the area of the floor outlet being two-thirds the area of the inlet, and the one at the ceiling one-third that area.

In conclusion, I would only add that our motto must be "Onward." It rests with us to educate the people to understand the gospel of fresh air, and we must not cease in our efforts until every home and school, church, public building, factory and works throughout the country are constantly flooded with this life-giving elixir, and the results will then be happier and healthier homes.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Proceedings of Fourteenth Annual Meeting, January 21-23, 1908

(Concluded)

Morning Session—January 23

The first paper on the programme at this session was on "The Relative Corrosion of Wrought-Iron and Soft Steel Pipe," by Thos. N. Thomson. This paper was read by the author and was published in full in THE HEATING AND VENTILATING MAGAZINE for January, 1908.

DISCUSSION

MR. CARY: The modern steel pipe is a work of art. In good steel pipe the metal has been carefully refined and we obtain a quality of pipe which is far above the average quality of wrought-iron pipe. When the wrought-iron contains many impurities corrosion becomes quite active. Pitting in pipes is caused by a different set of conditions than general corrosion. If the water contains considerable air in solution, as the air leaves the water it leaves it much purer in oxygen than in the atmosphere, and it is very much more active in its action on wrought-iron and steel than atmospheric oxygen. The bubbles of air appear on the surface at some central point, and it seems to me, after the action is once started at one of these points, other bubbles become centered at the same point. When the air and carbonic acid are delivered from the water together, the oxygen and carbonic acid getting together are much more corrosive than the oxygen alone.

If we find general corrosion occurring over a large area of pipe and covering it very uniformly, it may generally be traced to the presence of acid, and that acid may be an organic or an inorganic acid. Where pitting occurs it is almost invariably due to the presence of air in the water.

In the analysis given in Table I we have the solid contents of the water carefully analyzed, but no attempt seems to have been made to determine the quantity of dissolved air in this water. It is not safe to take the solid matter which will be precipitated in the water as an index of its pitting quality. In Switzerland there are large lakes supplied almost entirely by melted snow and it can be evaporated to dryness with a small trace of organic matter. In Glasgow the water is extremely pure. In the waters of the Irish lakes and most of the Scottish lakes there is a very large solution of air, and in the boilers in these localities very active pitting occurs, and they even have to mix a solution of quicklime in the water to protect the boilers and tubes from this active pitting action.

We examined a feed-water heater in Brooklyn where a tremendous pitting action had taken place and it was found to be due almost entirely to stray electric currents, short-circuited, and the tubes were badly corroded. But stray electric currents are not the only causes of pitting action.

Where there is zinc on pipes, if any electrolytic action occurs the zinc is more apt to disappear and the action will be at the expense of the zinc rather than at the expense of the iron, and as long as the zinc is near the point where this action is taking place, the iron will be more or less protected. I have gone to the trouble of suspending in boilers and feed-water heaters purest zinc, great care being taken in the selection, as in the ordinary zinc we find a considerable quantity of lead, so that action on the zinc takes place at the expense of the iron.

The rusting action is quite different from this pitting. In making investigations of this kind, it is well to note carefully why this rusting action takes place, whether there is a dissolving corrosive action due to the presence of acids and whether pitting action occurs. All three actions may be traced back to different causes and may vary in different localities and under different conditions.

PROF. CARPENTER: If there is a difference in the durability of steel and iron pipe, we want to know the cause of this difference. Chemically, iron and steel may be made to resemble each other very much, but differ from each other, of course, in the method of manufacture. If iron and steel can be made exactly alike chemically, then the difference must be that which is simply due to method of manufacture. The method of manufacture of iron, I take it, will always introduce considerable slag into

the material, whereas the method of manufacture of steel will keep the slag out. It is quite probable that if there is any difference, especially if these two materials have the same composition, it is due to the protecting action of the slag.

When steel pipe was first introduced, the complaints against it were numerous. These complaints have been getting less and less as the manufacturers have had more experience in the manufacture of steel pipe. That leads us to conclude that they are changing the composition of steel, and in that way making it approximate the iron, so that it works more like iron and behaves more like iron. It is a fact which, I think, is pretty generally admitted, that the addition of carbon and impurities to the iron acts in a measure to protect it from corrosion, and that may account for some of the differences.

I have believed for some time that the manufacturers of steel pipe would succeed in bringing it up to the point where it would equal iron pipe in every respect; that is, they would add the necessary impurities which have protected iron pipe in the past and they would get it into a condition so that it would not be so tough and would work better under the dies. This paper indicates that such a condition is being brought about.

It would be a matter of a great deal of interest if we had an analysis of these respective wrought-iron and steel pipes. Then we could see how they approximate each other in chemical composition.

Wrought-iron pipe could formerly be told from steel pipe very readily, but at the present time, in some instances, it is very difficult to distinguish it. I have noted in going through some of the factories that they are making alleged wrought-iron materials out of steel by using steel scrap instead of iron scrap, passing it through the hammer and, in that process, working in the slag, so that it looks and acts very much like iron. I think 80% of what is now commonly known as wrought-iron in the hardware trade is really steel. In one factory I noted that old rails were being cut up and manufactured into materials sold for wrought-iron. A great deal of wrought-iron pipe is, I understand, made of steel scrap and is, strictly speaking, not wrought-iron at all, but re-manufactured steel.

Prof. Kent: There is little known as to the exact cause of pitting, and why pipe should pit in one place more than in another. What we need is thorough investigation, not only by a chemist but by a microscopist to find the different compositions of the iron at different points and find out what conditions will make iron and steel corrode faster in one place than in another. One steel differs from another in carbon, manganese and silicon and all these three ought to have something to do with corrosion. Ordinary steel will vary in composition at different points, the top of the ingot will differ in its analysis from the bottom and the exterior from the interior. And Bessemer steel differs from other steels. So in wrought-iron. One wrought-iron is purer than another; that is, it contains less carbon. One wrought-iron has more slag than another. Anyone or more of these differences may possibly have an influence on the rate of corrosion.

Some twenty odd years ago, there was a discussion of the causes of the differences in the wearing power of steel rails, but no one really knew what was the cause. Not until many years later was it discovered by means of the microscope, and then it was found that the wearing power of rails was more a question of the temperature at which the rail was finished at the mill than it was of chemical composition. We may find something of the same kind in regard to the corrosion of wrought-iron and steel pipe.

Mr. Donnelly: Were all the wrought-iron samples cut from the same piece of pipe and steel likewise, made presumably in the same mill and of the same quality or was there a difference?

Mr. Thomson: There are ten samples of pipe here. Six of the samples came from the mill and I do not know whether they are of the same pipe or not. But the other four I obtained from the shops in Scranton. Three of these pieces I hold in my hand are wrought-iron and three are steel.

(The speaker here flattened one of the rings by hammering. Those that broke being classed as wrought-iron and those that flattened as steel.)

There is another test, the acid test. Here are two rings exactly the same as those experimented with and they have been subjected to the acid test by a structural engineer. He expected, of course, they would show up characteristic results of acid tests; that is to say, that the end of the steel pipe would be practically uniform because the texture of the steel is supposed to be uniform and close. The end of the wrought-iron pipe would be irregular—possibly little rings. Here is the result (exhibiting rings).

Prof. Carpenter: I am not wholly satisfied with the tests that Mr. Thomson has suggested to distinguish wrought-iron from steel. The test he has made would, I think, distinguish good steel from poor wrought-iron very readily.

Mr. Thomson: About two years ago I read a paper here on the physical properties of steel and I fully expected then to be called upon to distinguish the difference between wrought-iron and steel. So I cut off pieces of pipes and sent them to be analyzed and the

results tallied exactly with the results of my physical tests.

PROF. CARPENTER: I do not think to-day they would be successful.

MR. THOMSON: Some of these rings were made by the wrought-iron process and some were from so-called steel pipe. They came direct to me and when I hammered them the result of the physical test was in accordance with the difference between them.

PROF. CARPENTER: Good steel would have the same characteristics as wrought-iron. If they make a steel and load it with impurities it would be as brittle as iron pipe.

MR. DONNELLY: Mr. Thomson has taken the commercial pipe that is on the market. He got a good grade of steel and a poor grade of wrought-iron, so it is a fair average of the commercial pipe as found on the market to-day. I found a return pipe in an office building downtown so situated as to obtain some pitting. The pipe was weighed and the deduction from the loss in weight led to the inference that the pipe under such conditions lost approximately 1% of its weight per year.

Mention has been made that probably there was air or some gases liberated that caused the pitting. If that were the case, we might expect most of the pitting at the top, because, after heating, the air would naturally be at the top.

MR. CARY: You will find pitting not only at the top but in all portions of the pipe. The principal pitting action takes place while the water is at rest for a considerable time. Regarding pitting of galvanized pipe, we often find there is more or less defect in the galvanizing; it is not fairly distributed, and wherever the naked metal occurs the action will be centered more there than if that action could cover a greater area. The surrounding pipe with a zinc coating will be protected and where the action is at a particular point, deeper pitting will be found.

Corrosive action occurs where joints are brought together, where laps are made in boiler plates, the expansion and contraction of joints, exposing the bare metal at these particular points to corrosive action. This is known as "furrowing." We have that very often where joints are made so as to cause such action. I have tested a good, pure charcoal iron and have had it flatten without a fracture.

MR. THOMSON: I want to emphasize the fact that this is regular commercial pipe such as is bought for steam and hot water heating. That is the kind of pipe of which you construct your systems.

MR. BARWICK: I have a sample of pipe rusted by the action of the vapor from steam and salt water, the steam from New York City water and the salt water from the splashing of the waves under a dock. The pipe is pitted only on the outside. The pressure was about 7 pounds.

I have also two pieces of pipe, one of which was joined to the back of a ¾ in. connection, discharging into a low pressure return. The pieces were in nine months. The pitting in the steel pipe was in small spots.

MR. DONNELLY: What was the condition of the pipe at some distance from this point?

MR. BARWICK: Presumably in good condition.

MR. CARY: A thing that will have to be taken into account more than it has been so far is the result of the presence of air inside the radiators and inside the heating systems. It is a very important factor and it is responsible for a great many results that we have been discussing, including the subject of radiation and the value of radiating surface. Water condensed from steam is full of air and our large condensing engines cannot be operated without the removal of air from the water, and for that reson we have to put in these air pumps.

MR. BARWICK: Regarding the presence of air in heating systems, there is a question in my mind whether there is not more air in the water when practically used over again than in the water fed directly into the boiler.

MR. CARY: It is pretty generally known that water is the greatest of all known solubles, and where water is present in absolute purity, or approximating that condition, it searches for something to take into solution, and while we have a wasting away, due to the water dissolving the iron, it is a uniform waste and not a pitting action centered in isolated spots. The electrolytic action between the iron oxide and the pure iron itself, the one acting upon the other, makes a miniature battery at that point. Pitting action differs from general corrosion.

PROF. CARPENTER: We are not able to distinguish modern wrought-iron pipe from modern steel pipe in any test we can make in our laboratory.

MR. THOMSON: In regard to these fractures, I purchased some National Tube Company steel pipe and two years ago started in to absolutely determine the difference. These tests showed that the wrought-iron pipe showed up this fracture, characteristic of wrought-iron, the steel invariably closing up and bending like a rubber band. When the steel did break, it broke with a crystalline fracture.

PROF. KENT: How many samples were there?

MR. THOMSON: Fifty or sixty.

MR. BARRON: My opinion agrees with Mr. Thomson's, that Bessemer steel pipe

is bound to be the best that can be produced. But in selling steel or wrought-iron pipe, it depends on what the pipe is to be used for. If you use steel pipe where there is sulphuric acid in the water it is a dead failure.

MR. SPELLER: Prof. Carpenter is quite right in his declaration that iron can be made in ordinary practice so that it cannot be distinguished from steel, but such iron is not made for the purposes of pipe. Wrought-iron can invariably, in ordinary practice, be distinguished by the fracture test. A microscopic test is more delicate and it, also, checks up with the fracture test. In charcoal iron the difference is not so marked, but in ordinary iron the fracture test is as good as any test which can be devised.

MR. CARY: William Campbell, who was the microscopist of the great steel research committee in England and who did the greatest work ever done in that direction, is at present in New York. I induced him to give a lecture, with slides, showing the various qualities of iron and steel and the effect of work under various temperatures. If it is your pleasure, I will endeavor, at the next annual meeting in New York, to get Mr. Campbell to repeat that lecture, illustrated by slides, and show us how we may distinguish between different qualities of wrought-iron and steel.

(Upon motion of Mr. Barron it was resolved that Mr. Cary should invite Mr. Campbell to deliver the lecture referred to at the society's next annual meeting in January, 1900.)

(Upon motion of Mr. Chew, Mr. Thomson was invited to compile further information on the subject discussed in his paper, and to be assisted in his work by Mr. Miller and Mr. Speller.)

MR. VROOMAN: I think it would be of advantage if we asked the manufacturers and master steamfitters to form a joint committee to work on the subject. The engineer is a technical man and advises that certain things be done. The manufacturer provides the apparatus. The master steamfitter is the constructor who installs the apparatus and is able to tell whether the other two men have done their work properly.

MR. CARY: I think that the work can be done by this society and if the other societies wish to appoint special committees to work on this thing, the committee of this society will be glad to take up this thing with them.

PROF. KENT: This is purely an engineering question. The members of this society are engineers and there are some who are members of the master steamfitters' association.

MR. QUAY: I desire to take this opportunity to refer to the untimely death of Mr. Theodore L. Webster, of Warren Webster & Co., of Camden, N. J., who was killed in a railroad accident in that city, December 27th. We miss his genial presence, as he was always in attendance at our meetings, as well as was his brother, the two being inseparable.

Afternoon Session, January 23

The afternoon session was opened by the reading of a paper on "Fuel Economy," by L. J. Wing. Mr. Wing's paper was published in THE HEATING AND VENTILATING MAGAZINE for January, 1908.

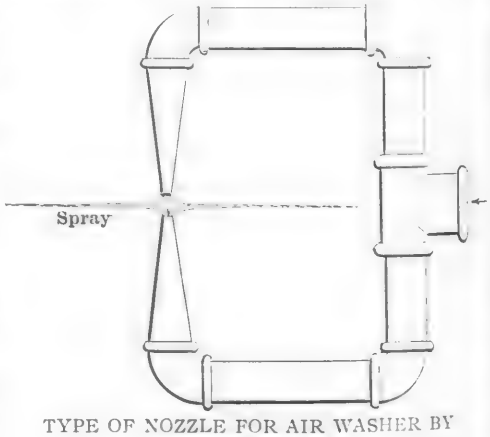
DISCUSSION

PROF. KENT: Referring to the sketch, there are three fans. First we have a fan to supply air to the furnace, and then a fan to draw the gases from the boiler. If there is insufficient heating surface in the boiler to reduce the gases to a reasonable temperature, we may have an economizer, if the coal is high enough in price to warrant it. Then we may have a fan to pull the gases through the economizer and deliver them to the chimney. We may go still further and put in a dust catcher. You have either one fan, or any two fans or all three fans and the air will flow just the same, whether it is pushed or pulled. The question of push or pull is a question of mechanical convenience and cost of installation and not one of economy of fuel, for the highest economy has been obtained equally with forced draft and with induced draft, whether produced by a chimney or a fan. Mr. Wing is entirely wrong in claiming superior economy for forced draft over any other kind of draft.

TOPIC NO. 5.

*Air Washers, Their Construction and Effect**

*The discussion of this topic brought out a number of drawings on the blackboard, which will be published, together with the revised discussions, in THE HEATING AND VENTILATING MAGAZINE FOR APRIL.—ED.



TYPE OF NOZZLE FOR AIR WASHER BY PROF. KENT

(On motion of Mr. Quay it was voted to appoint a committee to collect data on the subject of air washers and air washing.)

INSTALLATION OF OFFICERS

PRESIDENT SNYDER: We will now proceed with the installation of the newly-elected officers. I appoint Mr. A. S. Armagnac and Mr. Joseph Graham a committee to escort the newly elected officers to the rostrum.

After the new officers were assembled, President Snyder, in addressing them, said, "Gentlemen, it becomes my pleasant duty to turn over to you the work of the society for the ensuing year. I wish you every success."

The gavel was then presented to the new president, Mr. James Mackay, who said, "Gentlemen, members of The American Society of Heating and Ventilating Engineers, I appreciate highly the great honor you have conferred in electing me your presiding officer to occupy the chair so well filled by those splendid men who have been my predecessors. I feel a sense of gratitude for the success our society has achieved, but we have more work before us and it rests with you and the members of the society as to what we make of it. Your officers are of your creation, to carry out your desires and wishes and we bespeak your hearty coöperation and ask that you individually do what you can to make the coming year and all other years a success."

TOPIC NO. 6.

Testing and Rating House Heating Boilers

DISCUSSION

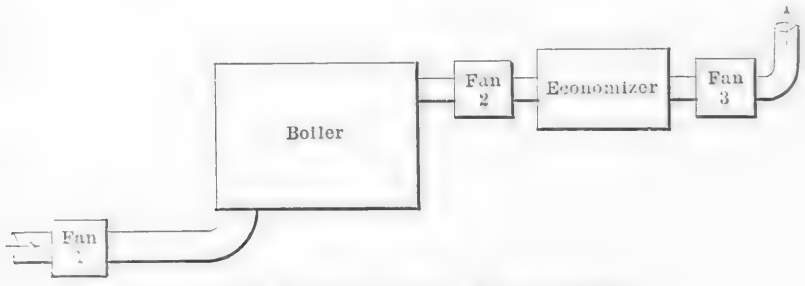
PROF. KENT: I sent to the secretary a paper on this subject. I have never seen anything heretofore published as to how to test house-heating boilers and so will read this. (The paper referred to by Prof. Kent is practically a revision of a paper read by him at a previous meeting of the society and recorded in Volume IX of the Proceedings. It has appeared in its present form in THE METAL WORKER and STEVENS INSTITUTE INDICATOR.)

TESTING CAST-IRON HOUSE-HEATING BOILERS

The testing of the evaporating power and the economy of small-sized boilers is more difficult than that of large steam-boilers for the reason that the small quantity of coal burned in a day makes it impossible to procure a uniform condition of the coal on the grate throughout the test, and large errors are apt to be made in the calculation on account of the difference of condition at the beginning and end of a test. The following is suggested as a method of test which will avoid these errors:

(a) Measure the grate-surface and weigh out an amount of coal equal to 30, 40, or 50 pounds per square foot of grate, according to the type A, B, or C, or the ratio of heating-to-grate-surface.

(b) Disconnect the steampipe, so that the steam may be wasted at atmospheric pressure. Fill the boiler with cold water to a marked level, and take the weight of this water and its temperature.



FUEL ECONOMY—PROF. KENT'S SKETCH

(c) Start a brisk fire with plenty of wood, so as to cause the coal to ignite rapidly; feed the coal as needed, and gradually increase the thickness of the bed of coal as it burns brightly on top, getting the fire-pot full as the last of the coal is fired. Then burn away all the coal until it ceases to make steam, when the test may be considered as at an end.

(d) Record the temperature of the gases of combustion in the flue every half-hour.

(e) Periodically, as needed, feed cold water, which has been weighed, to bring the water level to the original mark. Record the time and the weight.

CALCULATIONS

Total water fed to the boiler, including original cold water, pounds x (212°—original cold-water temperature) = ...B. T. U.

Water apparently evaporated, pounds x 966 = ...B. T. U.

Add correction for increased bulk of hot water:

Original water, pounds x (62.3—
59.8) ÷ 62.3 x 966 = ...B. T. U.
Total .....B. T. U.

Divide by 966 to obtain equivalent water evaporation from and at 212° F.

Divide by the number of pounds of coal to obtain equivalent water per pound of coal.

The last result may be considerably less than 10 pounds on account of imperfect combustion at the beginning of the test, excessive air-supply, when the coal bed is thin in the latter half of the test, and loss by radiation, but the results will be fairly comparable with other results from boilers of the same size and run under the same conditions. The records of water fed and of temperature of gases should be plotted, with time as the base, for comparison with other tests.

RATING HOUSE-HEATING CAST-IRON STEAM-BOILERS

The rating of a steam-boiler for house-heating may be based upon one or more of several data: 1, square feet of grate-surface; 2, square feet of heating-surface; 3, coal-burning capacity; 4, steam-making capacity; 5, square feet of steam-radiating-surface, including mains, that it will supply. In establishing such a rating the following considerations should be taken into account:

1. One square foot of cast-iron radiator surface will give off about 250 B. T. U. per hour under ordinary conditions of temperature of steam at 212° and temperature of room at 70°.

2. One pound of good anthracite or semi-bituminous coal under the best conditions of air-supply, in a boiler properly proportioned, will transmit about 10,000 B. T. U. to the boiler.

3. In order to obtain this economical result from the coal the boiler should be driven at a rate not greatly exceeding 2 pounds of water evaporated from and at 212° per square foot of heating-surface per hour, corresponding to a heat transmission of 2 x 966 = 1,932, or, say, approximately 2,000 B. T. U. per hour per square foot of heating-surface.

4. A satisfactory boiler or furnace for house-heating should not require coal to be fed oftener than once in 8 hours; this requires a rate of burning of only 3 to 5 pounds of coal per square foot of grate per hour.

5. For commercial and constructive reasons, it is not convenient to establish a fixed ratio of heating to grate-surface for all sizes of boilers. The grate-surface is limited by the available area in

	Low boiler	Medium	High boiler
1 sq. ft. of grate-surface should burn	3	4	5 lb. coal per hour.
1 sq. ft. of grate-surface should develop	30,000	40,000	50,000 B. T. U. per hour.
1 sq. ft. of grate-surface will require	15	20	25 sq. ft. heating-surface
1 sq. ft. of grate-surface will supply	120	160	200 sq. ft. radiating-surface
Type of boiler, depending on ratio heating-surface ÷ grate surface	A.	B.	C.

TABLE OF RATINGS

Type and No.	Sq. Ft. Grate.	Sq. Ft. Heating-surface.	Coal Burned Per Hr. Lbs.	Water Evaporated per Hr. Lbs.	Radiating-surface Supplied. Sq. Ft.
A 1	1	15	3	30	120
A 2	2	30	6	60	240
A 3	3	45	9	90	360
A 4	4	60	12	120	480
A 5	5	75	15	150	600
B 4	4	80	16	160	640
B 5	5	100	20	200	800
B 6	6	120	24	240	960
B 7	7	140	28	280	1,120
B 8	8	160	32	320	1,280
C 6	6	150	30	300	1,200
C 7	7	175	35	350	1,400
C 8	8	200	40	400	1,600
C 10	10	250	50	500	2,000
C 12	12	300	60	600	2,400
C 14	14	350	70	700	2,800
C 16	16	400	80	800	3,200

which it may be placed, but on a given grate more heating-surface may be piled in one form of boiler than in another, and in boilers of one general form one boiler may be built higher than another, obtaining thus a greater amount of heating-surface.

6. The rate of burning coal and the ratio of heating-to-grate-surface both being variable, the coal-burning rate and the ratio may be so related to each other as to establish condition 3, viz., a rate of evaporation of 2 pounds of water from and at 212° per square foot of heating-surface per hour.

These general considerations lead to the following calculations:

1 lb. of coal, 10,000 B. T. U. utilized in the boiler, will supply 10,000 ÷ 250 = 40 sq. ft. radiating-surface.

1 lb. of coal, 10,000 B. T. U. utilized in the boiler, will require 10,000÷2,000 =5 sq. ft. heating-surface.

1 sq. ft. of boiler heating-surface will supply 2,000÷250 or 40 ÷ 5 = 8 sq. ft. radiating-surface.

The table is based on the utilization in the boiler of 10,000 B. T. U. per pound of good coal. For poorer coal the same figures will hold good except the pounds coal burned per hour, which should be increased in the ratio of the B. T. U. of the good to that of the poor coal. Thus for coal from which 8,000 B. T. U. can be utilized the coal burned per hour will be 25 per cent. greater.

For comparison with the foregoing table the following figures are taken and calculated from the catalogue of a prominent maker of cast-iron boilers:

Height	G Grate.	H Heating-surface.	R Radiating-surface	$\frac{H}{G}$	$\frac{R}{G}$	$\frac{R}{H}$	B. T. U. per Hr. = R × 250	$\frac{\text{B. T. U.}}{H}$	Coal per Hr. per Sq. ft. grate *
Low.....	2.1	45	210	21.5	100	4.7	52,500	1,167	2.5
	4.7	90	600	19.1	128	6.7	150,000	1,667	3.2
Medium..	4.2	103	600	24.5	143	5.8	150,000	1,456	3.6
	8.2	195	1,500	23.8	183	7.7	375,000	1,923	4.6
High.....	6.7	210	1,200	31.3	179	5.7	300,000	1,476	4.5
	14.7	420	3,300	28.6	225	7.9	825,000	1,964	5.6

*Equals B. T. U. per hour ÷ 10,000 G.

I have figured the amount of coal to be burned per square foot of grate, 3 pounds for low pressure, 4 pounds for medium and 5 pounds for high. When you burn the coal more rapidly, of course, you require more heating surface to absorb the heat given out by the coal. The figures I have given were based on condition of the firebed being 12 inches thick. The paper as originally published was criticised by some boiler manufacturers, whose rating was higher than that, their rating of combustion being 8 pounds, but with a deeper fire pot.

MR. BARWICK: I notice that a letter from one of our members in France states that French architects are asking heating engineers to guarantee the amount of fuel that will be used by heating plants. We cannot give in advance a statement as to the amount of fuel that will be required because we are not running the plant.

I was called in in Paterson the other day to look over a hot-water boiler and will give you an illustration of the type. The party told me he had burned since the season started 20 tons of coal. The boiler had a capacity of only 635 sq. ft. of radiating surface. He asked my opinion. I told him, from the many plants I have figured and on which I based my calculations, he ought to burn 13 tons of coal the entire season.

I looked carefully over the plant. There were only one or two faults in it and one was in connection with one of the radiators. There was a dead end and the consequence was the heat backed up the other way. The two pipes were carried on the same level and there was little variation. I found, though, that he carried the smoke-pipe, as indicated in the sketch. I also noticed that the galvanizing had burned off, showing a very high rate of gases passing up his chimney. I found with the small size of the pipe that he could get only about 4 inches of fire—a high pot—and the fire would not last long. I suggested making the boiler two sections longer and he could then keep more coal on.

(At this point President Mackay announced that action had been taken by the Board of Governors making the treasurer of the society a member of the board.)

SPECIAL TOPIC

The Cost of Cooling Air by Refrigeration

DISCUSSION

MR. WEINSHANK: During the summer meeting I made the remark that to cool air for ventilation in the summer is commercially prohibitive. A gentleman asked me why. I gave him and the society a few results that I obtained from actual practice. Experiments have been

tried and come out as failures. I have since prepared some figures to prove my statement.

Take a case in Missouri, Kansas, and all through the middle west. Assuming a case of 92° outside temperature, with relative humidity of 90%, which is a condition we often have in the summer time. You know 90° is very hot if the humidity is great. Last summer in Texas it was 116° in the shade and I felt as comfortable as I did at home. The humidity was less than 50%. You take the temperature at 80° and the humidity at 90% and you feel uncomfortable. Referring to page 484 of Kent's Pocketbook, you will find there that at 92° the amount of moisture contained in one pound of air is equivalent to 0.03289 pounds—that is, the number of pounds of moisture or vapor to one pound of air, at 100% of humidity or at the point of saturation. Now 0.03289 x 0.90= 0.0296 pounds of water per pound of air. If we want to reduce the humidity, multiply .03289 by 0.50=0.164 the weight of water in the air after you go from 90% to 50%—0.0132 lbs. is the amount of moisture you will have to take out from each pound of air in order to reduce the air from 90% to 50%. In order to do that, we must abstract the heat, and in order to do that, multiply .0132 by 1109 and we get 14.8 B. T. U. In other words, from each pound of air we must remove 14.8 B. T. U. in order to remove so many pounds of moisture, the temperature remaining the same. But, in order to accomplish this you must cool the air. From 92 subtract 70, multiply by .238, and we get 4.76 B. T. U. Now then, we have 4.76 B. T. U. and 14.8 B. T. U. in order to bring the humidity down to be removed from the air. 19.5 will be the total multiplied by .072, the weight of one cubic foot of air, which we must reduce from 92° temperature and 90% humidity. 1.4 will be the horsepower. Figuring thus the result will be .0066 H. P. per cubic foot per minute, and 10,000 feet of air will take 66 H. P. A horsepower is $1.00. 66 x 5 = 330. It runs into money. The only place where it could be done is where they want to cool a space for a short period and the people have the money to pay for it. This proves the statement I have made that it is commercially impossible. I will give you the formula.

The first question asked is, how much will it cost? Using this formula you can tell the horsepower required, which means coal and which means dollars.

MR. QUAY: This brings us down to a definite basis. We were invited to estimate on a cooling system in a certain case and our estimate was $66,000. The system was not put in. I had another case where I was called in as expert. It was a system for cooling the basement and first floor of a building, 100 x 110 ft., and it cost $35,000. It costs so much to operate it that it has never been used.

MR. CARY: In the method described by Mr. Weinshank, the air is not run through the refrigerating machine. The method I used was to run the air through a system of coils in form similar to a hot blast heater. There was great trouble in doing that because of the freezing of the moisture from the air upon the outside of these coils. I had to use brine to avoid this freezing. With the freezing of the water there is all the moisture in the atmosphere upon the surface of the pipes and the temperature of the exterior of the pipes runs up to about 32°. To overcome that, I devised a scheme for putting brine over the face of these tubes and that removed the ice very rapidly. Besides freezing the atmospheric moisture you are apt to freeze additional moisture picked up by dry air. The brine was, of course, rapidly weakened because the condition of the moisture makes it weaker and weaker. By boiling and reboiling the mixture it was brought down to a certain specific gravity. The only way was by using the air over and over again. Fresh air will get in from time to time. The purity of the air was not much affected as impurities seemed to be taken up by moisture. Pure water will absorb these impure gases and fumes very rapidly.

Owing to the lateness of the hour the remaining topics on the programme were omitted and the meeting adjourned *sine die*.

Blowing and Drawing Air Through Hot Blast Coils

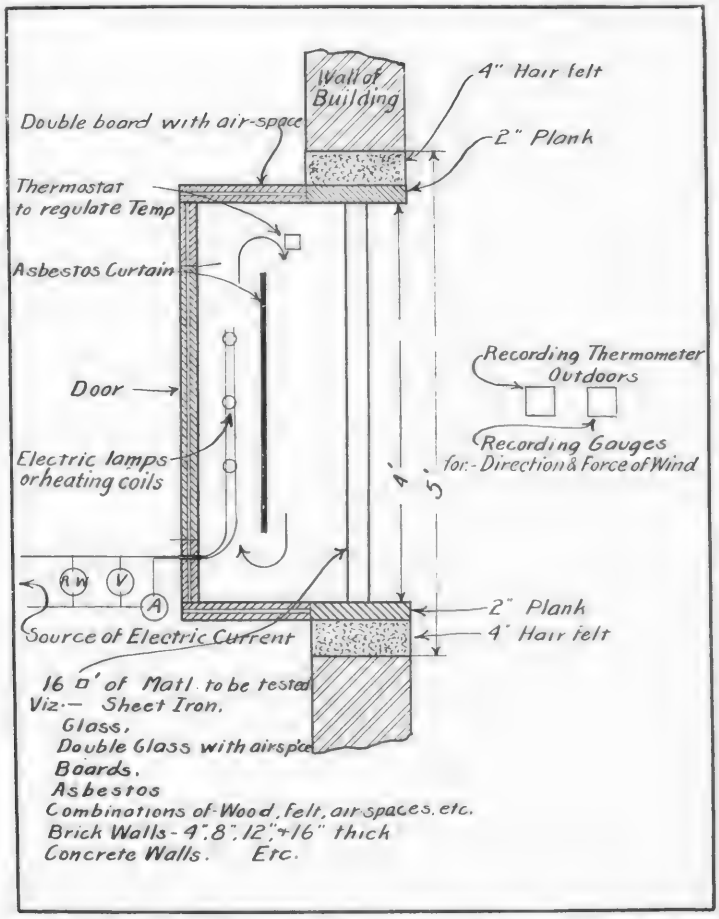
In the report of Mr. Weinshank's remarks in our February issue regarding the comparative advantages of blowing through hot blast coils and drawing through, Mr. Weinshank's revised remarks will give a clearer idea of his views as expressed. His revised discussion is as follows:

"In answer to Question 11, reply C says we are strongly in favor of drawing through the heater instead of blowing through; in other words, the coils should be placed preferably on the suction side of the fan. I cannot agree with that. If we draw through, it means we are handling air expanded from that of zero to 140°. It is true it will take less power to operate the fan, but with a fan designed to handle, say, 60,000 cu ft. of air per min., if the air is drawn through, it is only possible to handle 40,000 cu. ft. of air expanded at the same speed. On the other hand, if we blow through, we are blowing through cold air or air at 60°, and it becomes, say, 130° or 140°, so that we are discharging more air into the building."

A Method of Measuring Heat Transmission Through Various Materials

The following method of measuring heat transmission through various building materials was described by Prof. William Kent during one of the discussions at the recent meeting of heating engineers in New York:

I have here a sketch showing a proposed method of experimenting on the transmission of heat through different materials. The sketch shows a brick wall of a building with an opening 5 ft. square and having a casing made of 2-in. plank with a 4-in. strip of felt around it. four things, temperature of the air in the box or closet, temperature out of doors, force of the wind and direction in which the wind strikes. Inside we have the closet protected so as to keep the temperature of the closet from being affected by the temperature of the room. A sheet of asbestos is hung in the middle of the closet and behind it we put electric lamps, or a heating coil, with thermostatic regulation so that the temperature on the inside of the substance to be tested is kept constantly at 70°. The temperature inside being maintained constant, the variable outside temperature and the force and direction of the wind



APPARATUS DESCRIBED BY PROF. KENT FOR TESTING HEAT TRANSMISSION THROUGH VARIOUS MATERIALS

The box extends into the room, where the temperature is 70° or any other temperature ranging from 50° to 80°. We have in this space 16 sq. ft. of substance to be tested—it may be a sheet of glass, or boards, 16-in. brick wall, plaster or anything you wish to test. Outside we have a recording thermometer, a recording anemometer showing the force of the wind and a recording weather vane showing the direction of the wind. The amount of heat transmitted through the 16 square feet of substance depends on being autographically recorded, and the heat transmitted through the 16 square feet of substance to be tested being furnished by electricity and recorded by a recording wattmeter, we have all the data necessary for computing the amount of heat transmitted per square foot for various differences of temperature on the two sides, and for differences in the force and direction of the wind. This method would give results far more accurate than those obtained by Péclet's experiments.

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WE HAVE heretofore commented upon the importance of a fuller knowledge on the part of the general public regarding the practical operation of a modern heating and ventilating system. It is the height of folly for heating engineers to continue to work out their designs to an increasing degree of refinement when the chances are that the plant as installed will depend, to a large extent, for its successful operation, upon people who have very little idea of what the various devices are for, and who in times of trouble, usually of overheating, take the course that is most likely to put the systems out of working order. The plugging of thermostats and the opening of windows are but typical instances of ignorant attempts made to improve the operation of heating systems depending for their success upon the windows being kept closed.

ALL HEATING engineers can recall numerous cases where their work was entirely nullified by such interference. It is constantly occurring in public school buildings and the pupils are by no means the only offenders. In the New York City schools the complaints of principals and teachers regarding the heating systems led to an investigation a year ago which furnished abundant proof that no heating system could be expected to do its work under the conditions that had become common practice in many of the schools. This was all the more significant when it is stated that the investigating engineers found the work of the engineering department to be in accordance with the most approved practice as regards the heating and ventilating department.

THE INVESTIGATION has had a most important effect in convincing the authorities that it is essential that the teachers of public school buildings be instructed in the use of modern heating appliances and shown clearly the relation of the various parts of the system, together with the results sought to be obtained. The New York City Board of Education has, therefore, caused to be issued a manual of information and instruction which it has placed in the hands of every public school teacher in the city.

The manual will be found practically in full elsewhere in this issue and we publish it with the hope that the circulation of the matter it contains will not only be extended to the public schools of other cities, but that similar instructions will be given to the proper parties by every heating engineer.

A RULING, recently put into effect by the Department of Health of Michigan, amounts practically to a ventilation law, for the time being, at any rate, in that State. The State laws now provide that "before the board of any charitable, penal, educational or reformatory institution shall determine on the plan of any building, or on any system of sewerage, ventilation or heating, * * * such plan shall be submitted to the Board of Correction and the State Board of Health for examination and opinion thereon; and the board so submitting such plan shall, in its biennial report, show to what extent it was approved by the boards so examining them."

Acting on this authority, the State Board of Health has prepared a statement in which are mentioned different designs of heating and ventilating apparatus which it has placed virtually under the ban. Thus, by a process of elimination, a type of heating and ventilating system is secured that not only furnishes an ample supply of fresh air to public school buildings, but to other public buildings as well, which is true of no other State now having a ventilation law on its statute books, with the single exception of Massachusetts. Briefly summarized, the board's statement, which corresponds, in some respects, to the well-known "Form No. 83" in Massachusetts, is as follows:

Direct method of heating is not approved for the reason that it does not provide for the supply of fresh air to the rooms. Indirect method of heating recommended to be used instead. The direct-indirect methods of heating is also disapproved.

Fan method of heating. There are certain rooms in some State buildings, as assembly rooms and laboratories, in which the air can not be changed sufficiently often by natural draft, and for such buildings a forced draft is considered necessary. Plans submitted without special regulation of the air temperature in rooms are disapproved.

The taking of fresh air supplies from basement corridors, or from basement rooms not specially designed for the purpose, is disapproved. It is recommended that fresh air supplies be taken from outside the buildings. Wooden flues are disapproved.

The placing of fresh air and vitiated air registers in the floors of rooms is not approved, nor can the vitiated air registers be located "at any point above the floor line." They must be in the walls at the floor levels. The placing of the vertical ventilating flues in outside walls is not approved.

THE REQUIREMENTS for a sufficient air supply are contained in the section relating to "The Limited Areas of Ventilating Flues." We quote:

"In many plans submitted for examination, the ventilating flues are too small for the proper ventilation of the rooms by natural draft alone. The mistake is also frequently made of providing flues of the same areas for rooms of the same size and general character, but on different floors. Recommended that all ventilating flues be of the proper areas to effect changes of air equal to at least 33 1-3 cubic feet per minute for each person in ordinary day and sleeping rooms, and at least 50 cubic feet per minute for each occupant in hospital buildings, when the difference between the temperatures of the outdoor air and of that in the flues is not greater than 25°.

CORRESPONDENCE

Is the Question of Rating for House-Heating Boilers Possible of Scientific Solution?

EDITOR HEATING AND VENTILATING MAGAZINE:

There are very few of those who have intelligently studied this question who will not admit the desirability of having it accurately answered; but it is extremely improbable that a satisfactory answer can be made.

During the last annual meeting of the American Society of Heating and Ventilating Engineers, press reports state that the question was discussed; and a committee was formed to collect data on the subject. The very excellent report of the committee on hot-water heating gave much valuable information. A paper read by Mr. L. J. Wing rightfully declared that the question of fuel economy was one of the most important that could engage the attention of the society. Attention was drawn to the fact of the absurd and unsatisfactory methods of rating house boilers; and Mr. Quay rightly drew attention to the fact that it was an efficiency rating that was needed. There are probably a large number of scientifically educated engineers who think that they can mathematically demonstrate a solution of this question; but it is questionable if they can. It may be thought that laboratory power boiler testing methods can be applied to heating boilers in domestic use, which is a mistake. Even in laboratory testing practice, the results are only approximately correct estimates. I question whether it is possible to make any close approximation to accurate results in the comparative tests of house-heating cast-iron boilers, for the following reasons:

DIFFICULTIES IN THE WAY OF RATING BOILERS

1. Appliances of this kind should be tested for heat-generating capacity; for absorption and heat-distributing efficiency; for economic efficiency in the use of fuel; for capacity in caring for stated amounts of radiation; for ability in effecting the equalization of rates of combustion under neglected conditions of stoking; for quickness in steaming; for durability; for efficiency in management in securing a wide range of rates of combustion, and in the practical throttling of combustion, and for suitability of type to varying conditions.

2. In the methods of laboratory testing of boilers, fires are stoked carefully and continuously, and there is a relatively perfect combustion secured. The principle concern of the tester for power boiler efficiency is as to the amount of heating surface provided and as to the advantages of arrangement of heating surfaces. The furnace efficiency in power generating plants is secondary in importance to heating surface efficiency. In house heaters, furnace efficiency is the important point to consider; for, with infrequent fuel feeding and the maintenance of thick beds of fuel to last between infrequent feedings, and with consequent inequality of rates of combustion, we find the greatest source of loss—a source of loss so great that heating surface efficiency becomes a secondary matter, though of course an important one.

3. If proper ratings were given to house heaters, the factor of human variability in different testors becomes an important one to consider; and when we remember the great multiplicity of matters to be taken into consideration, this variable human factor is practically impossible to compute.

4. Any heating appliance can be given as many ratings as it is capable of producing rates of combustion. Who then is to determine what rate of combustion it is proper to use in testing for capacity? If a high rate of combustion is used, we secure a relatively good combustion, but defective heat transmission: for it is never going to pay to invest in sufficient heat-absorbing surface in a domestic boiler to absorb the heat in its rapid passage through the boiler during the rapid rates of combustion. That would only be needed during half a dozen days a year. For the greater part of the time these furnaces are run at very low or moderate rates of combustion to meet variable climatic conditions.

5. It would be practically impossible to accurately rate any boiler under actual conditions of work in different installations and at different times. Under actual condition of work the barometric and other atmospheric conditions are continually charging; no two charges of fuel are exactly the same as to size of fuel particles; different amounts of air are passing through the fuel from minute to minute, owing to change of form in fuel particles and ashes accumulating in different amounts all the time. The rate of combustion under actual conditions of work is changing from minute to minute; and the fuel values differ in different charges of fuel.

6. The process of heat absorption is greatly affected by the temperature of the feed water and the rapidity with which that water passes through the boiler, as well as by the way in which the travel of the water through the boiler is arranged for in relation to the travel of the gases through the boiler. The temperature of the feed water

and the rapidity of the rate of circulation of the water through the boiler is largely controlled by the amount of radiation, the degree of heat in the atmosphere surrounding the radiators, the moisture in the air, and the quickness of movement of the air over the radiators.

7. It is an exceedingly difficult matter to measure exactly the degree of heat absorbed in the boiler. Trying to do so by volatilizing vapor, or through the production of steam, is an extremely uncertain method, subject to many mistakes due to the quality of the vapor and steam evolved. Even with the more accurate methods of measuring water into which heat has been absorbed it is difficult.

8. The possibilities of error due to unmeasurable radiation, air dilution, and to the proportion of unconsumed fuel in the ashes are very great.

Now with all these points to consider, would any engineer like to guarantee an accurate estimation of the economic and other efficiencies of any boiler on the market in comparison with any other boiler? A standard for comparison is needed, but is it credible to suppose that any number of manufacturers of boilers are going to be helpful in bringing about any such comparative testing? The trade has been forced through one cause or other to cut down boiler weights to meet competitive activity. Practically every manufacturer to-day is making and selling boilers that are lacking in economic efficiency because of the absolute commercial need of being able to sell a boiler at a low initial cost. It seems to me that any possibility of securing an efficiency rating of boilers for all their various functional features is entirely out of the question. The question of economic efficiency and the possession of other merits must be largely left to the commercial presentation of the facts involved by the several manufacturers. It further seems probable, that any scientifically accurate rating of such boilers for capacity in caring for radiation is also out of the question; and that the matter of commercial supremacy must be largely left to the results of competitive trials under actual conditions of work. In the meantime, advisers and installers of heating plants may appeal to the knowledge gained from experience in enabling them to provide satisfactory heating provisions in cast-iron boilers.

Inquiry of those who have had a large experience in making such installations has drawn forth the following information: After determining the amount of radiation needed in the space to be heated, grate surface should be provided in the boiler to the extent of 100 square inches of grate surface for 100 square feet of radiating surface. This provides at least 25% more grate surface than even conservative makers claim will suffice. All experienced installers advise that it is a safe thing to select a boiler having 25% more heating power than is usually claimed to be sufficient. This is a wise provision inasmuch as it saves time by avoiding the necessity of too frequent replenishment of fuel; and does not call for too rapid a rate of combustion with consequent loss of unabsorbed heat that is conveyed too rapidly through the boiler. Furthermore, to secure a reasonably perfect combustion, and an equalized rate of combustion, a properly introduced supply of air for combustion over the fuel mass is necessary. This method of air feeding reduces the intensity of the rate of combustion, and produces a larger volume of heating gases of an average lower temperature than the temperature of incompletely burned gas. To make this larger volume of heat of a lower temperature available, and to secure enough generation of heat at a lower rate of combustion, it is necessary to use a boiler of sufficient size.

So far as the amount of heating surface needed is concerned, my experimental experience in this line indicates that, as a general rule, it will be found very profitable to provide in the hot water or steam boiler an absorptive capacity that is the equivalent of at least 50 square feet of indirect heating or flue surface to each square foot of grate surface. In estimating the value of heating surface we may consider every square foot of surface exposed to the direct radiation of the fire to equal about 4 square feet of indirect or flue surface. In case of running a fire at a very rapid rate of combustion, a very much larger amount of heating surface should be provided. In fact, as a rule, it will probably be found to be economical to provide 50 feet of well arranged flue surface and all the direct heating surface that can be provided. Probably not more than 10 to 12 square feet of direct heating surface to one of grate can be provided in a heating apparatus of extra width and of, say, 66 inches high. The amount of heating surface needed will largely depend upon the arrangements for gas travel and air feeding in the appliance under consideration.

DR. J. M. W. KITCHEN.

East Orange, N. J., March 2, 1908.

Economy of Vacuum System

EDITOR HEATING AND VENTILATING MAGAZINE:

What per cent. of saving in fuel would there be in a steam-heating apparatus that was run with a 150 H. P. tubular boiler, with 75 H. P. simple non-condensing Corliss engine, with exhaust from the engine connected to low pressure steam-heating apparatus, which contains 12,000 feet of radiation? Boiler pressure 80 lbs., pressure on heating system 5 lbs.

with returns run to receiver and pump to boiler with duplex pump. Also what saving would there be for 10 lbs. back pressure on heating system? The saving I had reference to was if a vacuum system was constructed, using a vacuum pump. The amount of coal now used is 375 tons per year, which includes the coal used for power purposes during the summer.

J. S. BANKS.

Milwaukee, Wis., March 3, 1908.

In order to aim at accurate conclusions it would be necessary to have more data than is given in this case. We can give an approximate answer, however, by making the following assumptions:

Engine is running to its full capacity, 75 H. P. Its steam consumption is about 25 lbs. per H. P. per hour. Its m. e. p., under atmospheric conditions, is about 45 lbs.

The total amount of steam from the engine would supply only 6,000 sq. ft. of the total 12,000 sq. ft. of heating surface, and we will consider only the saving that might result from the removal of back pressure from the engine by the use of a vacuum system.

Assuming that with a back pressure of 10 lbs. the coal consumed for running the engine only is about 260 lbs. per hour, a saving of about 12% of this amount will be effected if the back pressure is reduced to 5 lbs. and if it is to be reduced to zero, a saving of about 20% will result.

The additional live steam for supplying the other 6,000 sq. ft. will have to be added under any circumstances and while there are combinations of conditions which might make it desirable to apply figures to this quantity, we believe they can be neglected for present purposes.

Consolidation of Heating Engineers With Mechanical Engineers

EDITOR HEATING AND VENTILATING MAGAZINE:

I read with interest your editorial in the February issue of your journal regarding the proposed union of the American Society of Heating and Ventilating Engineers with the Mechanical Engineers' Society. I think if a vote were taken on this proposition, two out of every three members of the heating engineers society would be in favor of consolidating. We can never hope to attain the proportions of any of the "big" societies. They have their new building all paid for so that their income from dues, etc., can be devoted to tests, investigations and such work, which we are not able to do and will not be, probably for years to come. The heating engineers' society's principal object is to advance the art of heating and ventilating and not to boom itself simply as an organization. I hope you obtain a general expression of opinion on this subject as I, for one, would be heartily in favor of a consolidation.

MEMBER.

Chicago, March 6, 1908.

EDITOR HEATING AND VENTILATING MAGAZINE:

The editorial in your February issue on the heating engineers uniting with the mechanical engineers is timely, but I do not think it will come to pass. We have been for fifteen years now building up our organization. It has a certain personality acquired through years of struggle and is now in a position where it can afford to be independent. If, as your editorial states, the suggestion had come six years ago, when our future was more uncertain, I think it very likely that we would at least have entertained the suggestion. Our society has made it something to be a heating and ventilating engineer and such a title on a man's letter-head has come into use more and more during the last few years. Our society has thus benefited not only our members but all engaged in the business, and if we made any deal now with any bigger society it would simply mean that we would be swallowed up. Moreover, I do not think it would properly designate many of our members to call them mechanical engineers, for many of them are not and are not supposed to be experts in mechanical engineering such as would entitle them to membership in the mechanical engineers' society.

T. K. L.

New York, March 3, 1908.

EDITOR HEATING AND VENTILATING MAGAZINE:

I am in favor of amalgamation. To over 50% of the membership in the American Society of Heating and Ventilating Engineers it would be a distinct advantage to be members of the Mechanical Engineers' Society.

G.

Philadelphia, Pa., March 8, 1908.

American Society of Mechanical Engineers

The semi-annual meeting of the society will be held in Detroit, Mich., June 23-26. Among the features on the programme will be a symposium on the conveying of materials.

The March meeting of the society was held March 10 in the Engineering Societies Building, New York, and was addressed by Dr. Charles P. Steinmetz, who spoke on "The Steam Path of the Steam Turbine."

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Annual Convention in Boston, June 15, 16, 17 and 18

The annual convention of the National Association of Master Steam and Hot Water Fitters will be held in Boston, June 15-18, 1908.

American Society of Heating and Ventilating Engineers

The Board of Governors met in Chicago February 13 and discussed, among other things, the place for holding the summer meeting of the society. Although no decision was reached a preference was expressed by some of the members for Niagara Falls.

Relation of Heating Surface to Efficiency of Boilers

During the discussion at the recent meeting of The American Society of Heating and Ventilating Engineers regarding the rating of house-heating boilers a remark was made that one boiler manufacturer had cut out about one-third of the heating surface of his boiler and increased its rating about 20%. Speaking on this subject Prof. William Kent said:

A gentleman said awhile ago that we can get more heating effect under a boiler by taking away some of the heating surface, or words to that effect. It is rather risky to make a general statement like that and make it cover all cases. We must have all the conditions. Take, for instance, a vertical boiler built up of several superimposed horizontal sections. Suppose you have an anthracite fire at a temperature of about 2,500°. Suppose the surface was so proportioned and the amount of heat supplied was such that when the gases got through the lowest section the temperature was reduced to 1,500°, and that successive sections reduced the temperature by 300°, 200°, 150°, 75° and 60°, each one absorbing less and less heat until you get to the point where it would not pay to put on any more sections. After passing the top section the final temperature is 715°. If you take off that section, you might have 775°, and if you take off another, 850°. The more heating surface you put on, the more efficient the boiler. The less heating surface, the less the efficiency of the boiler.

Trade Literature

Book of the Economizer, published by the Green Fuel Economizer Co., Matteawan, N. Y., is a new publication which will be found of interest and value to all who manage, design or operate steam power plants. It takes up the history and merits of the Green Fuel Economizer, and also such engineering topics as the absorption of heat by different parts of the boiler surface; the relative economy of boiler surface and economizer surface under various conditions, methods of determining the economy of additional heating surface from the load curve; the effects of oil fuel, high steam pressures and superheat on boiler economy; methods of measuring the temperature of flue gases; and reports of various tests of boiler plants containing economizers.

One chapter is devoted to a novel explanation of the often observed fact that the economy from preheating boiler feed water is greater than would be found by calculating the ratio which the heat contributed by the feed-water heater or economizer bears to the whole amount of heat required for evaporation. The explanation briefly summarized, is, that if with a constant rate of combustion and constant flow of gas through the boiler, the economizer takes on part of the boiler's work by heating the feed water the boiler does not lay down the whole amount of work of absorbing heat that the economizer takes up, but does additional work by absorbing nearly as much heat and evaporating more water than before. This is to be expected, since with a given difference of temperature between gas and water, the rate of heat transmission through the boiler surfaces should remain the same. Size, 6x9 in. Pp. 160, including illustrations and tables.

New Book

Practical Steam and Hot Water Heating and Ventilation by Alfred G. King. 6 x 9¼ in. Pp. 402. Price, $3.00. New York: The Norman W. Henley Co.

Mr. King's book is a new treatise on this subject which is designed to give all the necessary information to the beginner in heating and ventilating engineering, as well as some points that will be read with profit by the more experienced engineer. The book is handsomely printed on coated paper and the illustrations have been prepared with care and are unusually well executed. The book is intended for the practical man and for that reason the more scientific aspects of the art are carefully avoided. An entire chapter at the end of the book is taken up with rules, tables and similar information which form a complete and useful reference. There is also a full index. Size, 6x9¼ inches.

The Weather During February

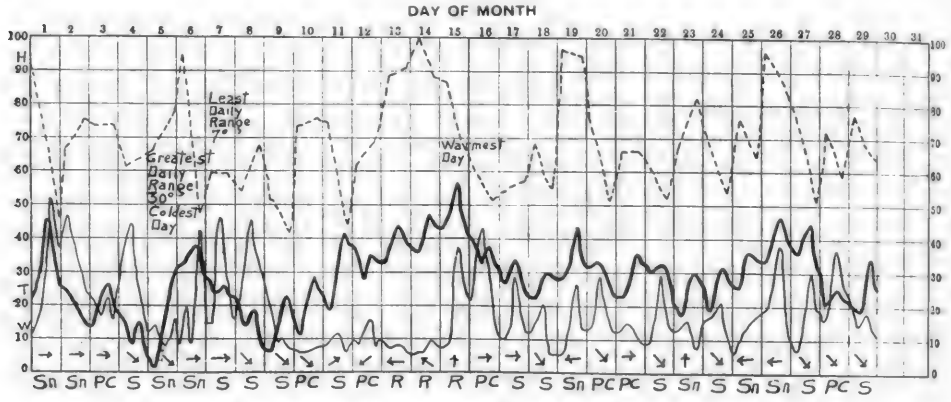
During February the weather in many parts of the country made amends for the unusually mild months of December and January. This, however, was more noticeable in the east, the mean temperature in New York, for instance, being 3° below normal while the mean temperature in Pittsburg was 4° below normal. But in Chicago the mean temperature was 1° higher than usual. St. Louis returned figures corresponding with the average mean temperature in that city.

NEW YORK

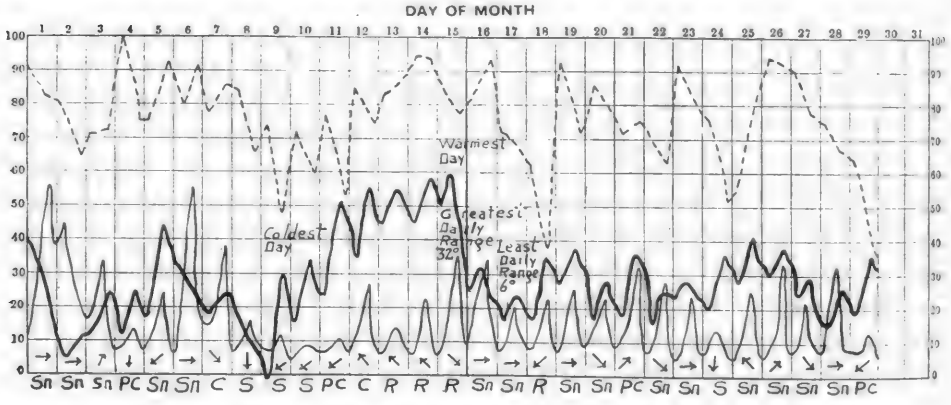
The highest temperature in New York was 56° on the 15th and the lowest, 1° on the 5th. The greatest daily range was 30° on the 5th and the last daily range, 7° on the 7th. The mean temperature for the month was 28°, 3° below the mean for this month for 38 years. The total precipitation for the month was 5.36 inches; there was a total snowfall of 13.7 inches. The greatest precipitation in any one day was 2.03 on the 19th. There was no snow on the ground at the end of the month. The prevailing direction of the wind was northwest and the total movement, 11,035 miles; average hourly velocity 15.9 miles. There were 11 clear days, 10 partly cloudy, 8 cloudy and 11 on which rain or snow fell. There were dense fogs on the 13th and 14th.

PITTSBURG

In Pittsburg a high temperature of 60° was recorded on the 15th and a low temperature of minus 1° on the 9th. The greatest daily range was 32° on the 15th and the least daily range 6° on the 17th. The mean temperature of the month was 28°, 4° below normal for 38 years. Total precipitation, 2.89 inches; snowfall, 13.5 inches. Greatest precipitation in any one day, 0.80 inches on the 5th. There



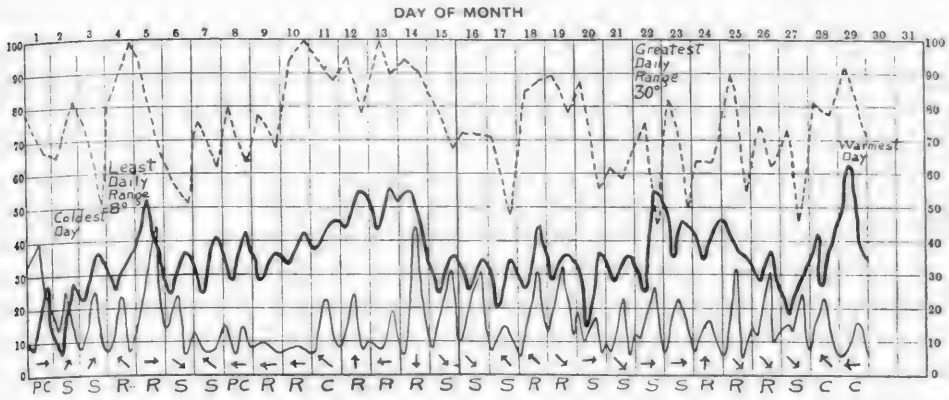
RECORD OF WEATHER IN NEW YORK FOR FEBRUARY, 1908



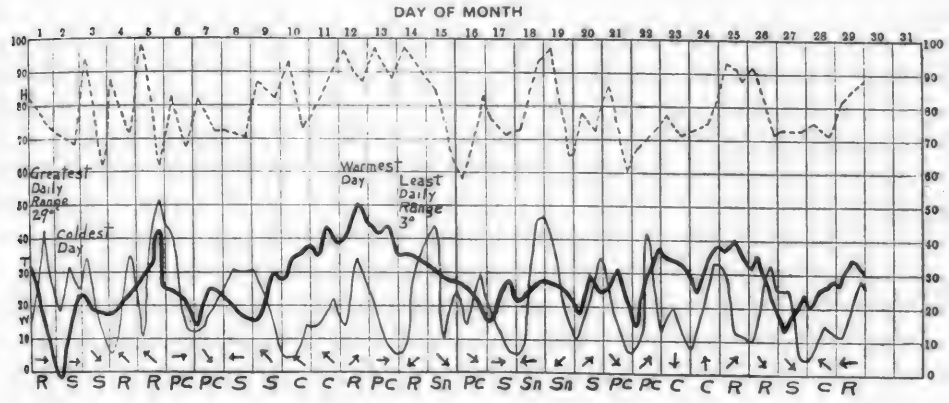
RECORD OF WEATHER IN PITTSBURG FOR FEBRUARY, 1908

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

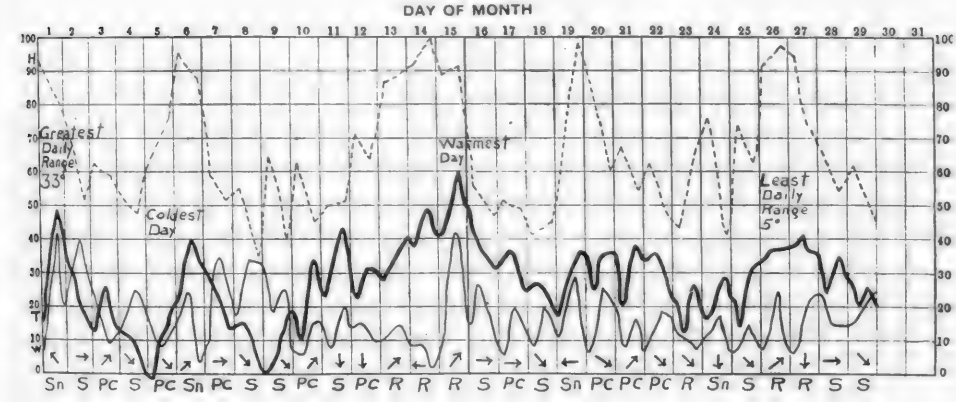
Upper line indicates temperature in degrees Fahr.
Dotted line indicates relative humidity in percentage from readings taken at 8 a. m. and 8 p. m.
Lower line indicates velocity of wind in miles per hour
Arrows fly with prevailing direction of wind
S—Clear. PC—Partly Cloudy. C—Cloudy. R—Rain



RECORD OF WEATHER IN ST. LOUIS FOR FEBRUARY, 1908


DAY OF MONTH
Greatest Daily Range 29°
Coldest Day
Warmest Day
Least Daily Range 3°
R S S R R PC PC S S C C R PC R Sn PC S Sn Sn S PC PC C C R R S C R

RECORD OF WEATHER IN CHICAGO FOR FEBRUARY, 1908


DAY OF MONTH
Greatest Daily Range 33°
Coldest Day
Warmest Day
Least Daily Range 5°
Sn S PC S PC Sn PC S S S PC S PC R R R S PC S Sn PC PC PC R Sn S R R S S

RECORD OF WEATHER IN BOSTON FOR FEBRUARY, 1908

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Upper line indicates temperature in degrees Fahr.
Dotted line indicates relative humidity in percentage from readings taken at 8 a. m. and 8 p. m.
Lower line indicates velocity of wind in miles per hour
Arrows fly with prevailing direction of wind.
S—Clear. PC—Partly Cloudy. C—Cloudy. R—Rain.

was only a trace of snow on the ground at the end of the month. The prevailing direction of the wind was west; total movement, 9,484 miles; average hourly velocity, 13.6 miles. There were 4 clear days, 10 partly cloudy, 15 cloudy and 17 on which rain or snow fell.

ST. LOUIS

In St. Louis, 62° on the 29th was the highest temperature recorded and the lowest, 6° on the 2nd; greatest daily range, 30° on the 22nd and least daily range, 8° on the 4th. The mean temperature for the month was 34°, corresponding to the average for 35 years. Total precipitation, 3.39 inches; snowfall, 4.4 inches; greatest precipitation in 24 hours, 1.13 inches on the 14th. There was no snow on the ground at the end of the month. Prevailing direction of wind, northwest; total movement, 9,315 miles; average hourly velocity, 13.4 miles. There were 12 clear days, 5 partly cloudy, 12 cloudy and 13 on which rain or snow fell.

CHICAGO

The highest temperature during the month in Chicago was 50° on the 12th and the lowest, minus 2° on the 2nd; greatest daily range, 29° on the 1st and the least daily range, 3° on the 14th. Mean temperature for the month, 27°, 1° above the average for 38 years. Total precipitation, 3.72 inches; snowfall, 19.8 inches. Greatest precipitation in 24 hours, 1.27 inches on the 18th-19th. Snow on ground at the end of the month, 3.7 inches. Prevailing direction of wind, northwest; total movement, 12,860 miles; average hourly velocity, 18 miles. There were 7 clear days, 5 partly cloudy, 17 cloudy and 11 on which rain or snow fell.

BOSTON

In Boston the highest temperature recorded during the month was 60° on the 15th and the lowest, minus 2° on the 5th; greatest daily range, 33° on the 1st; least daily range 5° on the 26th. The mean temperature for the month was 27°, 1° below the average for 38 years. Total precipitation 2.96 in.; snowfall, 9.3 in.; greatest precipitation in one day, 0.84 in. on the 19th. There was only a trace of snow on the ground at the end of the month. Prevailing direction of wind, northwest; total movement, 8,992 miles; average hourly velocity, 12.9 miles. There were 11 clear days, 9 partly cloudy, 9 cloudy and 10 on which rain or snow fell. There were fogs on the 6th, 13th and 14th.

Deaths

James Powell, president of the William Powell Co., valve manufacturers, Cincinnati, Ohio, died February 25 at his home in Avondale. He was 77 years old. Mr. Powell was born in Belgium, but most of his life was spent in Cincinnati. He was for many years engaged in the general machinery business, and was associated with the Union Brass Works in that city. He was one of the charter members of the National Association of Manufacturers and was a founder, and a former governor of the Manufacturers' Club of Cincinnati. Mr. Powell was also a past grand master of the Odd Fellows and a member of the Queen City Club. A son and two daughters survive him.

Enoch Rutzler, president of E. Rutzler Co., 127 White street, New York, steam and hot water heating contractors and manufacturers of exhaust heads and other heating specialties, died at his home in Brooklyn, February 29, of pneumonia. Mr. Rutzler had been identified with the steam fitting trade in New York for over 30 years. He was a well-known figure at the conventions of the heating engineers and master steam and hot water fitters. At the latter gatherings the rôle had for long been allotted to him of making the customary motions of thanks at the conclusion of the convention, an occasion looked forward to with keen anticipation, for his impromptu speeches were always tactful and witty. In the development of the art of heating and ventilation, Mr. Rutzler has borne a prominent part and a number of devices patented by him, such as his exhaust head, are in general use.

Lyman D. Mills, heating and plumbing engineer and contractor, of Middleton, Conn., died at his home in that place February 25, at the age of 54 years.

John C. Kupferle, manufacturer of hydrants and other water and plumbing supplies, died in St. Louis, Mo., February 7. He was 71 years old.

Thomas J. Byrne, a veteran member of the national Association of Master Plumbers and for years an influential worker in the development of that trade died at his home in New York, February 29.

Edward G. Burnham, founder and former president of the Eaton, Cole & Burnham Co., Bridgeport, Conn., manufacturer of steam fitting supplies, died at his home, February 28. He was 80 years old. In the early sixties, Mr. Burnham established the firm then known as Belknap & Burnham, the company assuming its present name in 1874.

E. W. Herrick, of the engineering staff of Baker, Smith & Co., New York, heating and ventilating contractors, died at his home at River Edge, N. J., March 3, of ptomaine poisoning. Mr. Herrick contracted the malady while on a vacation trip to Pinehurst, N. C. He had a wide acquaintance in the trade and the news of his death comes as a painful surprise to his many friends. He is survived by a widow.

TRADE AND MISCELLANEOUS NOTES

Miscellaneous Notes

National Association of Master Plumbers will hold its annual convention in Boston, Mass., July 14, 15, and 16, at the Hotel Lenox, in the Back Bay district.

Building operations for January, 1908, continue to show reduced figures as compared with those of a year ago. In the eastern cities, the decrease was as high as 50%; middle west 33%; south, 57% and Pacific coast 42%.

George E. Eliot, chief chemist for Lunkenheimer Co., of Cincinnati, Ohio, addressed the Stationary Engineers' Club in that city, February 11, on the subject of "Corrosion in Steam Plants."

Builders' Exchange League, Pittsburg, Pa., at its annual meeting, elected the following directors, representing the master steam and hot water fitting trade: P. F. Maginn, James S. McVey, R. S. Smith and H. Williams. The representatives of the master plumbers elected were: Joseph A. Weldon, S. S. White, J. H. Folsom and D. G. Deeley.

Portland, Me.—The second annual dinner of the commercial travelers in that section representing the steam fitting, plumbing and sheet metal trades, was scheduled for March 9 at the Falmouth Hotel, in Portland.

Chicago, Ill.—A decision has been handed down by a Chicago court to the effect that tenants who prefer to remain in insufficiently heated apartments rather than take the risk of breaking their leases must suffer the consequences. They cannot bring suits for damages against the landlords. If one remains in an apartment one cannot demand damages for failure to supply adequate heat, unless there is a specific provision in the lease to the effect that adequate heat shall be supplied.

Little Rock, Ark.—Central Heating and Manufacturing Co.'s hot water heating system, which extends over a large portion of Little Rock, was shut

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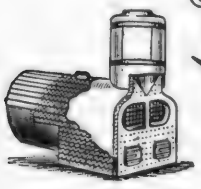

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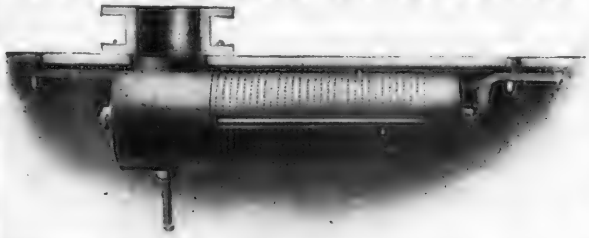

are both increased by using "THE POTTER" MESH SEPARATOR, the only efficient boiler dry-pipe.

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down for three days recently during one of the cold spells, on account of five breaks in the mains. Over 200 homes, business houses and other buildings were left without any heat from that source and much hardship resulted.

Kansas City, Mo.—Following the burning of the power plant which furnished heat and power to the union station buildings at Kansas City a freight engine did the duty of a steam heating plant. A large steel hopper car, filled with coal, was attached to the engine, which is doing satisfactory service in its novel rôle.

St. Louis, Mo.—The city council has killed the heating franchise bill introduced by Joseph G. Branch and John Van Rensselaer, on account of their refusal to name their financial backers. The company proposed to develop power by the utilization of the city garbage.

Hattiesburg, Miss.—The city council has found that the steam wasted from the city waterworks plant would heat the greater part of the city if properly piped to the various buildings. The local theatre and the city hall is already being supplied in this manner and the city council is planning to extend the system.

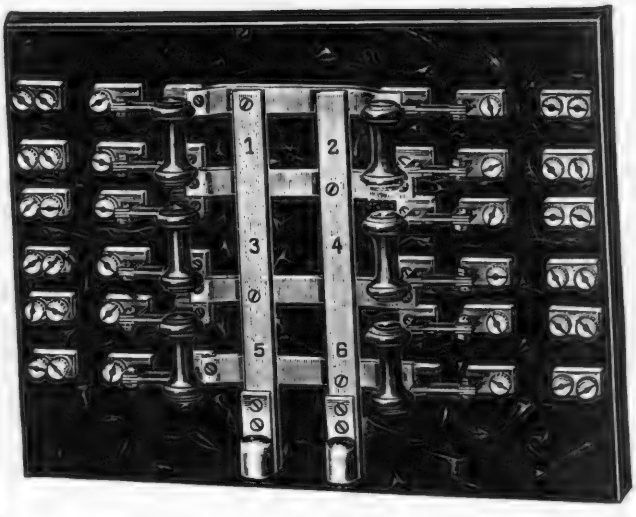
Manufacturers' Notes

Union Radiator Co., Johnstown, Pa., will build a new addition to its foundry for the manufacture of additional types of radiators, including a slip nipple wall radiator, made in four heights. The company's new assembling room, 50 x 100 feet, recently completed, has increased the capacity of this department about 20,000 square feet of radiation a day.

Pittsburg Valve & Fittings Co., Pittsburg, Pa., announces that it has moved its general offices in Pittsburg to Barberton, Ohio, where the company's works are located.

L. O. Koven & Bro., New York, manufacturers of hot water galvanized-iron boilers and expansion tanks and sheet metal products, held a house-warming at its new factory building in Newark, N. J., February 8, when a dinner was served to a large number of employees and other guests, followed by a vaudeville entertainment. Addresses were made by L. O. Koven, Gus Koven, Fred Meissner, of Hoboken, the architect of the building, by the president of the Jersey City Board of Trade, and by William M. Mackay, who designed the hot water heating system in the building. A plant independent of the exhaust system for the other buildings was installed, in order to insure warm tools and machines when the men reported for work on cold mornings.

Paul Steam System Co., New York, has brought suit in the United States court against George Brumder for in-



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If you want quick deliveries and first class material.

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fringement of patents on attachments for the regulation of the circulation of steam. The devices on which the Paul System Co. claims patents are used in the Germania Building, New York.

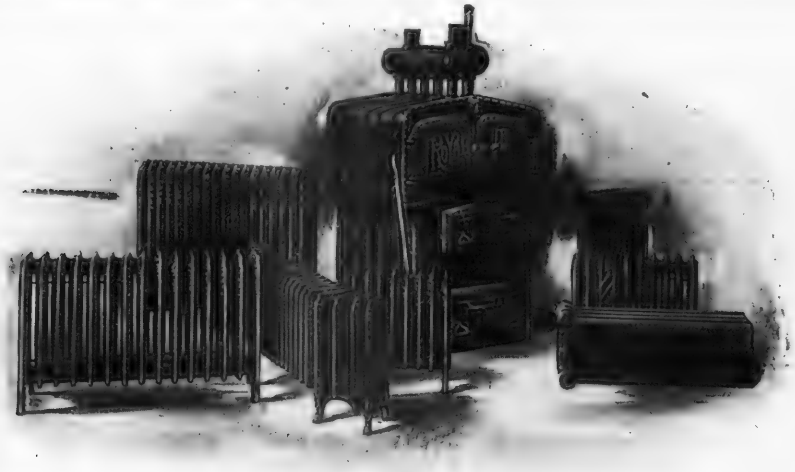
American Radiator Company's annual meeting, held March 4, showed the past year, ending January 31, to have been a prosperous one, despite the falling off of business during the last months of the year. The net profits for the year were $899,724, an increase of $35,443. The usual dividends, totaling $210,000, were paid on the preferred stock, while on the common stock dividends of $300,000 were paid, which is an increase of $100,000 over those of the previous year. Owing to the larger dividends on the common stock, the surplus was $389,724, which is a decrease of $64,557 from that of the previous year. The company, however, has now a total surplus of $3,773,795. In his report President Clarence M. Woolley said among other things:

"The company has steadily enlarged its producing capacity, and, following conservative policies, the business has gradually increased until the volume annually transacted exceeds its capitalization. This enables the company advantageously to transact the larger volume of business on a smaller percentage of profit, rendering available to a greater number of people with moderate means its sanitary and home improving products. The company passed through the panic of 1907 without stress or strain, and emerged therefrom with cash on hand approximately equal to its liabilities."

Thatcher Furnace Co., New York, announces that the name of the Bernhard boiler, which the company recently acquired, has been changed to the Progress boiler.

Niagara Radiator & Boiler Co., North Tonawanda, N. Y., announces that it will market a number of its new types of apparatus this spring. W. S. Newkirk, the New York manager of the company, has spent much time at the company's works in connection with the manufacture of the new product.

Colwell Lead Co., New York, manufacturer of plumbing supplies, has acquired a controlling interest in the Callahan Supply Co., Worcester, Mass. Thomas A. Callahan has been elected a director of the Colwell Lead Co., and will continue to act as manager of the Worcester establishment. The Colwell Lead Co. is planning to build a new eight-story building for its showrooms and warehouse, to be located at Lafayette and Walker streets, near its present location.



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New Incorporations.

Evans' Plumbing & Heating Co., Freeport, Ill. Capital stock, $8,000. Incorporators: T. E. Beck, Charles E. Evans, and William B. Holmes.

Taylorville Railway, Heat, Light & Power Co., Springfield, Ill., capital $5,000, to operate a heat and light plant. Incorporators: J. A. Adams, A. M. Moore and L. J. Perkins.

Graebing Automatic Ventilating Co., New York, capital $120,000, to manufacture ventilating apparatus. Incorporators: Lawrence S. Graebing, Tuckahoe, N. Y.; Leonard Day, 45 Broadway, New York; and Burton E. Cummings, Ridgefield Park, N. J.

Harwood Electric Heating Co., Hutchinson, Kan. Capital stock, $30,000.

Rugby Plumbing & Heating Co., Rugby, N. D. Incorporators, H. J. Shaw and George T. McLean.

No Draft Ventilator Co., Westbrook, Me., to manufacture ventilating devices. The company will have a capital stock of $10,000. Officers: President, George M. Woodman; treasurer, Benjamin J. Woodman.

Wright, Alexander & Co., Rochester, N. Y., capital $75,000, to engage in heating and plumbing contracting business. Incorporators: Robert B. Wright, David A. Alexander and Albert N. Wright, all of Rochester.

C. Brenner & Sons, Buffalo, N. Y., incorporated to take over the heating and plumbing contracting business of C. Brenner & Sons. Incorporators: Christian, C. H. and Albert J. Brenner, all of whom were co-partners in the old firm.

Foster Plumbing and Heating Co., Tuscaloosa, Ala., has been incorporated.

J. M. Kohler Sons Co., Chicago, Ill., capital $75,000, to deal in heating and plumbing supplies.

Business Changes

Knox-Gilchrist Co., 157 West avenue, Buffalo, N. Y., has succeeded to the heating and plumbing contracting business of W. J. Gilchrist. R. T. Knox, the new president of the company, has been associated with the company for several years. Mr. Gilchrist will retain a financial interest in the firm.

Stewart & Vacha, Washington, Ia., have purchased the heating and plumbing business of E. L. Saling. The business will be continued under the name of the Washington Plumbing and Heating Co.

Rawson & Griebenow Co., Withee, Wis., are preparing to do an extensive manufacturing business in tank heaters, a new type of which has been patented by William Griebenow. The tanks will be manufactured at Owen.

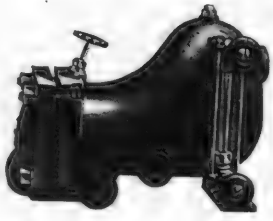
Buchanan-Boughton Co., Marshalltown, Ia., has succeeded to Barker & Buchanan. Mr. E. T. Barker retires from the firm and Mr. M. J. Boughton has acquired an interest in the business.

J. B. Hart, Auburn, Wash., has bought the heating and plumbing business of Davis & Son and will combine it with his own business.

Ofte Radiator Co., Alexandria, Va., is the changed name of the Patent Fin Hot

McDaniel Improved Steam Trap

WILL DO THE WORK



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Water Heating Co., decided on at a recent meeting of the corporation. It was also voted to raise the capital stock from $150,000 to $300,000.

Collins & Nelson, Batavia, Ill., have dissolved partnership, and E. F. Collins will continue the business.

Creston Plumbing & Heating Co., Creston, Ia., has been purchased by C. S. Rice, proprietor of the Creston Cornice Works. The entire stock has been removed to 109-111 Elm street, where the business will be run under the same name.

Midland Supply Co., Davenport, Ia., which has succeeded the heating and plumbing jobbing house of the Davenport Steam Heating Co., has moved into its new quarters at 602 East Fourth street.

Madill & Dawson, Watertown, N. Y., has been dissolved, the senior member of the firm associating himself with George H. Gleason, a prominent heating and plumbing contractor in Watertown.

Crook-Kries & Co., 227-231 West Saratoga street, Baltimore, Md., has purchased the entire mechanical and contracting department of Crook-Horner Co., of that city, and will make a specialty of heating, ventilating and electrical contracting and machine work. The firm is composed of Henry A. Kries and H. E. Crook, both of whom were formerly with the Crook-Horner Co.

New Firms

Independent Plumbing Co., 307 Donner street, Monesson, Pa., is a new firm that has engaged in the heating and plumbing contracting business. Robert Evans and C. L. Chester, both of Belle Vernon, are the principals.

John Habel, Benton Harbor, Mich., has opened a steam and hot water contracting business at 147 Wall street.

Business Chances

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following-named work:

Until March 24, 1908, for the construction (except elevators and lift) of the U. S. Post Office and Court House at Grand Rapids, Mich.

Until April 6, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Hazelton, Pa.

Until April 7, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and

WEBSTER STEAM SPECIALTIES

What do you Expect?

People who have lived with old-fashioned steam pipes, or ordinary heating systems, can hardly appreciate the

WEBSTER SYSTEM OF STEAM CIRCULATION

at first. They have not learned to expect enough.

You should expect a heating system to keep one person's room at 65°, even if the next keeps his at 80°; to be as noiseless as a sleeping cat; to "lift" the water of condensation over a two-foot wall if necessary; and yet to cost the least for fuel.

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THE DIFFERENT PIPE COVERING FOR HEATING SYSTEMS

Asbestocel is the most efficient pipe covering for hot water, hot air and steam heating systems, because it is the only one in which the air cells run around the pipe, instead of lengthwise. Therefore, it confines the greatest amount of dead air.

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pays for itself every year in fuel saved.

It is fire-proof—an important feature in a pipe covering.

Is made in sectional form for steam and hot water pipes; in sheets for boilers, heaters, etc.; in rolls for furnace pipes.

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New York, Milwaukee, Chicago, Boston, Philadelphia, Los Angeles, Cleveland, Buffalo, Baltimore, New Orleans, Kansas City, Minneapolis, San Francisco, Pittsburg, Dallas, London, St. Louis, Seattle

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wiring) of the U. S. Post Office at Nevada, Mo.

Until April 8, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office and Custom House at Portsmouth, Va.

Until April 9, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Dixon, Ill.

Until April 9, 1908, for the low pressure steam heating apparatus for the U. S. Post Office and Court House and extension thereto at Tyler, Texas.

Until April 10, 1908, for the construction of an extension to and the remodeling of the U. S. Post Office and Court House at Jackson, Miss., including plumbing, gas piping, heating apparatus, electric wiring and conduits.

Until April 11, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Bessemer, Ala.

Until April 15, 1908, for the construction complete (except elevators and lift) of the U. S. Post Office, Court House and Custom House at Tacoma, Wash.

Juneau, Wis.—A report was adopted by the county board of supervisors, January 31, proposing an enlargement of the County Insane Asylum, by the construction of an additional building, including a heating and ventilating plant. A special committee of the supervisors has been directed to procure plans, etc., and report to the Spring, 1908, session of the board.

Caro, Mich.—The Caro public schools will be equipped with steam heating systems as soon as the summer vacation commences. Steps looking toward this change were taken some time ago, but lack of time and the fact that the furnaces now in use were still doing the work led to a postponement.

Beatrice, Neb.—The Burlington Railroad will commence the erection of two new sections to their roundhouse at that point and will equip the house and shops with their own electric light and heating plant.

Contracts Awarded

Everington-Bradley Co., Minneapolis, Minn., hot-water heating residences of C. H. Bowhan and M. B. Robinson; also steam-heating W. F. Andrews' brick store, that city.

Van Sickle & Warren, Cleveland, I., hot-water heating G. W. Grandin's new residence in the Wade allotment.

H. Kelly & Co., Minneapolis, Minn., steam heating and ventilation in new

Zinc-Coated Steel Slip Nipples

For Steam and Hot Water Radiators and House Heating Boilers

THE PRATT CHUCK CO., Frankfort, N.Y.

FREE SAMPLES furnished to interested parties

part of the Madison State Capitol, at about $30,000.

Southern Heating Co., Memphis, Tenn., heating new State Normal School building at Conway, Tenn; also new Memphis public school.

Fred. Egan, East Pittsburg, Pa., steam heating and plumbing addition to the Wilson Hotel, that place.

Mellott Heating Co., Pittsburg, Pa., hot-air heating large business and apartment building for Dr. W. A. Terheyden.

Hilltop Roofing Co., Pittsburg, Pa., heating contract for store and residence at West Liberty.

Pittsburg Valve, Foundry & Construction Co., Pittsburg, Pa., has been given the contract for the piping installation for the new open hearth steel plant being built by the Pittsburg Steel Co., at Monessen. The contract calls for steam piping up to 24-in. diameter, main water piping up to 30-in. diameter. The equipment will include, in addition, fifteen 500 H. P. Sterling Boilers, 3 large mill engines and 3 cross-compound electric generator engines.

Wanted

Young man, familiar with steam and hot water fitting trade, to represent contractor in New Jersey, New York and vicinity. Address Contractor, care of THE HEATING AND VENTILATING MAGAZINE.

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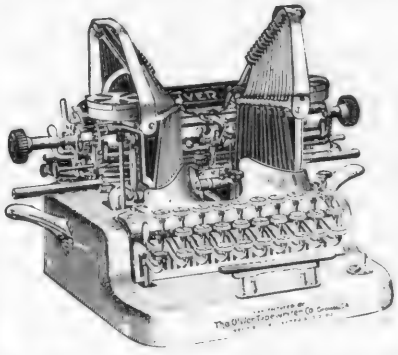

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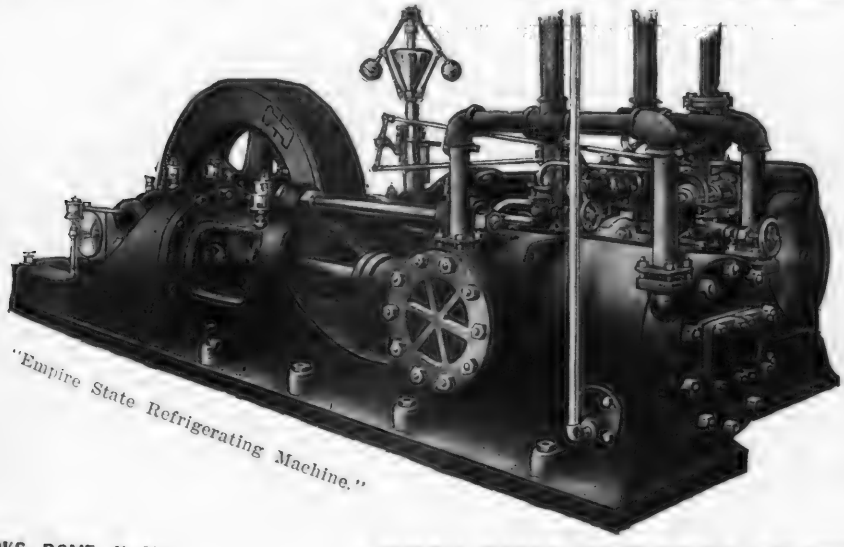
The Maxfield Steam Engine

For belting or direct connecting to dynamos, pumps, blowers, stokers, disc fans and general power 3 H. P. to 30 H. P. All speeds. Small space.

Dust proof, durable, simple, efficient.



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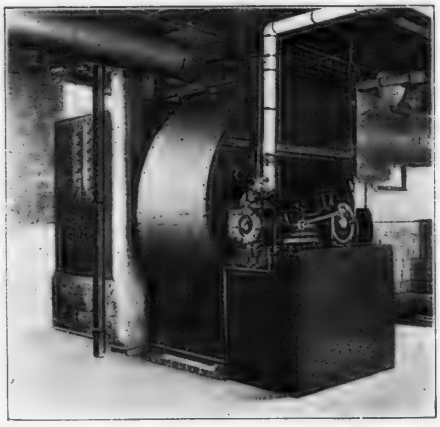


GREEN HEATER, FAN AND ENGINE

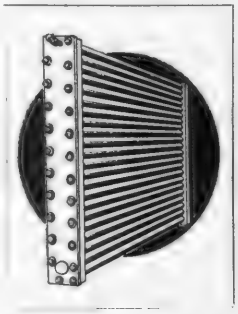
¶ The tubes are straight, and, by removing the cover plate of the cast-iron header, the interiors of the tubes can be inspected and cleaned or a leaky pipe can easily be mended, plugged or removed. The tubes are standard one-inch pipe, which can be bought anywhere and inserted by anyone who knows how to expand a tube into a header. There are no leaky elbows.

¶ As the steam or water flows through the tubes in a uniform and positive stream, there are no spaces that can become air bound, nor do some tubes offer shorter passages for the steam than do others, as in U-shaped sections. Further, the steam cannot pass directly from inlet to outlet without going through the pipes, as it can in many types. All the steam must pass through the tubes in order to get through and out, and every tube must receive some steam. The course of the steam is always downward, and drainage is therefore perfect.

¶ The construction of this coil, permitting it to be cleaned easily, makes it especially suitable for the utilization of exhaust steam containing oil, or for cooling by means of the circulation of cold water, since deposits of scale and sediment are easily and quickly removed.

¶ We are selling these heaters with a guarantee that with given temperatures and air velocities, a given amount of heat will be transmitted. Among many other installations are the Kimberly & Clark Paper Mills, the Atlas Wire Co., the Sherman Envelope Co., the Diana Paper Co., the Fargo & Morehead St. Railway Co., New York Public Schools, Worcester and Providence Technical Institutes, The Great Northern, The Chicago & Northwestern and Atchison & Santa Fe Railways.

¶ The Green Heater enables you to get the most heat transmission from the least number of lineal feet of heating surface. ¶ Ask for our "Heating and Ventilating Booklet" 109 HV and our Treatise 107 HV on "Drying Materials."



SINGLE SECTION OF GREEN HEATER

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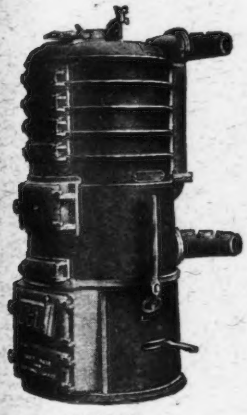
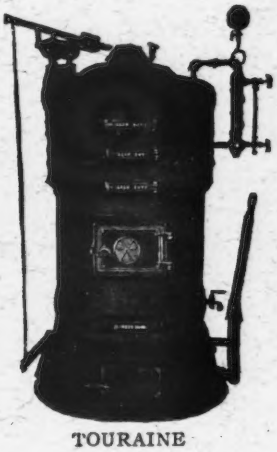
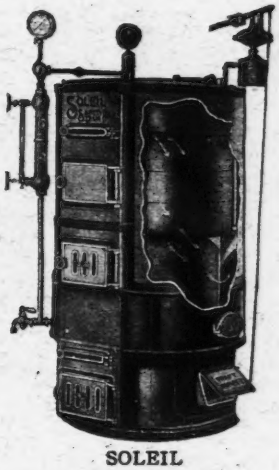


SPENCE



TOURAINE



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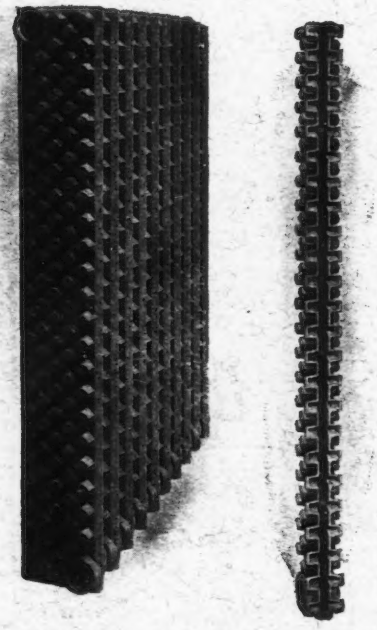
For Blower Work.

As commonly known a 1-inch wrought steel pipe used for a blast heater coil has an area of .7854 square inches; while the cross sections of a Vento Cast Iron Heater has 8.8 square inches. This increased area per lineal foot of steam travel prevents both air binding and the holding of condensation in suspension, due to the partial vacuum which may occur in the pipe.



Note the cross section view showing the cored interior and full value extended surface.

All the constructive features of the Vento Cast Iron Blast Heater are formed with reference to a free circulation within a large cored interior which presents heating surface of highest value to heating results in air blast work.

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